

**Economic and Social Council**

Distr.: General
10 January 2008

Original: English

Commission on Sustainable Development

Sixteenth session

5-16 May 2008

Item 3 of the provisional agenda*

Thematic cluster for the implementation cycle

2007-2008 — review session

Discussion papers submitted by Major Groups**Note by the Secretariat****Addendum****Contribution by workers and trade unions******Contents**

	<i>Paragraphs</i>	<i>Page</i>
I. Introduction	1-3	2
II. Trade union assessment of progress since the World Summit on Sustainable Development.	4-38	2
III. Moving forward with workplace action and agreements	39-44	18

* E/CN.17/2008/1.

** The views and opinions expressed do not necessarily represent those of the United Nations.



I. Introduction

1. The main purpose of workers and trade unions at the sixteenth session of the Commission on Sustainable Development will be to review progress on the social dimension of sustainable development, and specifically on commitments defined for workplaces, work processes and the communities in which workers and their families live. Workplaces are at the hub of production and much of the world's consumption of products provide a forum for social interaction and change. Our mission is to ensure that workers, with their energy, knowledge and organizations, are involved in the changes that must take place.

2. Trade unions are active in sustainable development work on the basis of chapter 29 of Agenda 21, taking part in sessions of the Commission, the Organization for Economic Cooperation and Development (OECD), the Food and Agricultural Organization of the United Nations (FAO), the World Health Organization (WHO), the World Trade Organization, the International Labour Organization (ILO), the United Nations Environmental Programme (UNEP), and numerous other forums. They are represented by the International Trade Union Confederation and the Trade Union Advisory Committee to OECD, which together speak for over 168 million members in 153 countries and territories, as well as by Global Union Federations, which represent workers in specific sectors.

3. In January 2006, trade unions and SustainLabour partnered with ILO, UNEP and WHO to convene the first Trade Union Assembly on Labour and the Environment in Nairobi, in which over 200 trade union leaders and activists reached a common position on sustainable development linking poverty reduction, social justice, environmental protection and decent work.¹ Later in 2006, the Trade Union Sustainable Development Unit was launched as an information and data service coordinated by the International Trade Union Confederation, the Trade Union Advisory Committee, the Global Union Research Network and SustainLabour to analyse and report on progress, focusing on indicators for sustainable development. Country-by-country data relating to themes of the Commission's sixteenth session are available at www.tradeunionsdunit.org/profiles/.

II. Trade union assessment of progress since the World Summit on Sustainable Development

4. Trade unions regard the themes of the Commission's sixteenth session as a closely interrelated cluster embodying environmental, social and economic concerns. World Summit on Sustainable Development outcomes in these areas provide an agenda for our review, and it is within that context that trade unions address their priorities; in particular regarding agriculture, rural development and land use within the context of the multifunctional character of agriculture and land, with special attention to agricultural workers and Africa, where many issues are most urgent.¹

¹ See www.global-unions.org/pdf/ohsewpO_6d.EN.pdf.

A. Effective integration of the three pillars of sustainable development

World Summit on Sustainable Development outcomes/trade union priorities

5. The Plan of Implementation of the World Summit on Sustainable Development ("Johannesburg Plan of Implementation"), the Johannesburg Declaration on Sustainable Development,² and Agenda 21 (confirmed by the Summit) call for the complete integration of the three dimensions of sustainable development into programmes and policies with attention to the social dimension and support for social protection systems. Poverty eradication and social development are to be integrated with sustainable patterns of production and consumption. As well, the outcomes note the work of the International Labour Organization on the social dimension of globalization and the need to promote enhanced participation of civil society and other relevant stakeholders in the implementation of Agenda 21, to promote transparency and broad public participation.

6. Agriculture and food are basic to our civilization, and patterns of development in these sectors are therefore crucial to plans for sustainable development. World Summit on Sustainable Development outcomes demand an all-encompassing review according to the principles underlying the multifunctional character of agriculture and land. The concept of the multifunctional character of agriculture and land is based on the premise that agricultural land is where workers live, raise families and build communities. It values local control and good industrial relations, with workers involved in decision-making, target-setting, implementation, auditing and reporting, with a role for trade unions as contemplated in chapters 14 and 29 of Agenda 21, on sustainable agriculture and rural development. Half of the world's workers are engaged in "agricultural production", and, while many are victims of unsustainable practices, they are also in a position to promote changes throughout the food chain.

The record since 2002

7. Although trade unions note some progress towards the multifunctional character of agriculture and land, much of the evidence points to a downward spiral in the agriculture and food system, with developments like "factory farming" pushing environmental degradation to crisis levels, combining deterioration of water quality and toxic inputs with some of the worst employment practices. The domination of food and agriculture by a few large multinational corporations results in growing influence over agricultural production and consumption through aggressive retailing, undermining the ability of local communities to grow crops for their needs, or to exercise stewardship of the land, with negative implications for safety and security of food supply. Liberalized terms of trade and deregulation have resulted in free movement of hazardous technologies and products around the world, with little attention to environmental and social costs or security of food, particularly in developing countries.

² Adopted at the 17th plenary meeting of the World Summit on Sustainable Development, on 4 September 2002.

Box 1**Preserving farmland and community in India**

In 2007, PBKMS, the union affiliated with the International Union of Food, Agricultural, Hotel, Restaurant, Catering Tobacco and Allied Workers' Association (IUF), joined workers, small farmers and villagers of Singur, West Bengal, to prevent the loss of 400 hectares of farmland to a Tata Motors small car project that would deprive 30,000 people of their land and livelihood. Camps are permanently occupied by villagers and leaders of the Farmlands Protection Committee, with daily rallies and meetings. Protesters have been attacked by police armed with batons, shields and tear gas. Many families living near the acquired land are in urgent need of food and medicine (see www.iuf.org).

B. Poverty eradication as a focal point of sustainable development**World Summit on Sustainable Development outcomes/trade union priorities**

8. The Summit called for concerted measures at all levels to enable developing countries to achieve poverty-related targets within a sustainable development context. This includes the Millennium Development Goal of halving by 2015 the proportion of people whose income is less than \$1 a day and those who suffer from hunger or lack access to safe drinking water. It called for a world solidarity fund to eradicate poverty, promote social and human development in developing countries, mobilizing the effective use of financial resources to improve living standards and increase food availability and affordability, and equitable and efficient distribution systems, by promoting, for example, community-based partnerships linking urban and rural people and enterprises.

The record since 2002

9. For hundreds of millions of workers around the world, particularly agricultural workers, the Summit outcomes are far from being realized. For nearly half of the global population (3 billion people) who live on less than \$2 a day, and the 1.5 billion who live in extreme poverty, poverty eradication is a dream. According to FAO, proper nourishment is denied to nearly 800 million people in developing countries and 34 million in industrialized nations, with children the most vulnerable.

10. Global climate change could negate poverty reduction gains, particularly for those who make a living from the land in Asia, home to over 60 per cent of the world population and 87 per cent of the world's known 400 million small farms. The expansion of biofuel crops linked to deforestation could worsen climate change and increase emissions, as well as lead to conflict between crops grown for food and those grown for fuel (see *Up in Smoke? Asia and the Pacific* at www.neweconomics.org/gen/asiaupinsmoke191107.aspx). This disproportionate effect of climate change on agriculture, particularly for the world's poorest, has been predicted by the Intergovernmental Panel on Climate Change in its fourth assessment report, which projects that the worst impacts in the short to medium term will come from increased variability of weather, with more frequent and extreme events like storms, droughts, floods and heat waves. Impacts on agriculture will particularly affect Africa, where production will be severely compromised. The

irony is that it is these people who are least to blame for climate change, but stand to lose the most.

C. Decent employment as a key aspect of sustainable development

World Summit on Sustainable Development outcomes/trade union priorities

11. The Summit called for decent employment as a route out of poverty, and called for assistance at all levels to increase income-generating employment taking into account the ILO Declaration on Fundamental Principles and Rights at Work, as well as poverty programmes that reflect priorities of the poor and enable access to productive resources, public services and institutions. It called attention to ILO and the United Nations Educational, Scientific and Cultural Organization Conventions to end gender-based discrimination and for improved access by indigenous people and their communities to full, sustainable employment that contributes to safe, clean and healthy work, community and physical environments. Participation of workers and their trade unions must be promoted in environment and development programmes, including employment, industrial strategies, labour adjustment programmes and technology transfers.

The record since 2002

12. This review cannot ignore the fact that so much of the world's food and agricultural production continues to be carried out under unacceptable and unsustainable conditions, particularly by waged agricultural workers, who comprise 60 per cent of workers in developing countries and are ironically among those least able to afford the food they produce. They are on the frontline of a system that is seeing continual increase in demand for agricultural products, countered now by production of biofuels. With a projected increase in world population to 9 billion by 2050, the demand will increase even more.

13. The majority of the poor in developing countries live in rural areas, where millions work as small and medium-sized farmers, peasants and shareholders, or in informal relationships and as forced, slave or indentured labour, or as child labourers. As FAO, ILO and IUF point out in their report *Agricultural Workers and Their Contribution to Sustainable Agriculture and Rural Development (2006)*, poverty is also a factor in commercial operations, with migrant labour a major issue. Today, agricultural workers on full-time, secure contracts of employment are an exception, as most are seasonal, casual or temporary. A large number are migrant workers, working for low pay, with little job or social security or unemployment benefits. Trade Union Country-by-Country Profiles reveals that some Governments allow or even promote precarious employment practices and deprive a growing number of workers of trade union protection (see www.tradeunionsdunit.org/profiles).

Box 2

Decision makers commit to action for decent work, decent life

Signing the "Call to action for decent work, decent life" in November 2007, decision makers committed to: changing unfair trade rules, protecting the rights of workers to organize, ratifying and implementing the United Nations and ILO Conventions around the protection of migrant workers and providing social protection to the

60 per cent of the world population who live without it. Signatories include dignitaries such as the Director-General of ILO, the Under-Secretary-General for Economic and Social Affairs, the Chairperson of the ILO Governing Body, the Labour Minister of Argentina, the Labour Minister of Brazil, the Labour and Social Security Minister of Portugal and the EU Presidency, and the President of the Party of European Socialists. The campaign is collecting signatures through national coalitions that include trade unions (see www.ituc-csi.org).

14. Attention must be given to the some 25 million persons who have already become environmental refugees as a result of climate and weather events; according to some predictions, 100 million persons will be directly at risk from coastal flooding by 2100.³ The Intergovernmental Panel on Climate Change has suggested that the number of those at risk could reach 150 million by 2050, many of whom will be extremely vulnerable. The German trade union IG BAU is one of many unions to respond with programmes for migrant workers. It co-founded the European Migrant Workers Union and, in 2007, launched a campaign on the theme "Fair seasonal work", which includes a labelling scheme denoting good labour practices in enterprises. As well, DGB, the German national trade union centre, maintains a department to provide services to migrant workers.⁴

Box 3

Global Union Federation provides a charter of rights for migrant workers

IUF has produced the "Charter of Rights for Migrant Workers in Agriculture" to educate trade union affiliates on migrant worker issues, noting risks from unscrupulous labour contractors, racism and xenophobia. To defend and organize these workers, IUF has vowed to expand activities to construct bipartite and multilateral international agreements between affiliates in the countries of origin and destination, and an international union card. It notes that the fundamental right of both employers and workers to join organizations of their choosing is enshrined in the principle of freedom of association as expressed in the ILO Right of Association (Agriculture) Convention, 1921 (No. 11), the Freedom of Association and Protection of the Right to Organize Convention, 1948 (No. 87) and the Rural Workers' Organizations Convention, 1975 (No. 141), all of which are integrated into the ILO Declaration on Fundamental Principles and Rights at Work.

³ See www.ipcc.ch/pdf/assessment-report/ar4/wg2/ar4-wg2-chapter6.pdf.

⁴ See www.migration-online.de.

D. Child labour and gender-based discrimination

World Summit on Sustainable Development outcomes/trade union priorities

15. The Summit called for measures to end child labour and for adjusted/gender-sensitive programmes to address problems faced by women working in agriculture and food, including violence and discrimination, and to improve the status, health and economic welfare of women and girls through full and equal access to economic opportunity, land, credit, education and health care. It called for an end to gender-based discrimination with equal employment opportunities and remuneration for all workers, whether in formal or informal working relationships, and for adequate economic, political and social support systems and services, including child-care and parental leave, and an increase in the proportion of women decision makers, planners, technical advisers, managers and extension workers in environmental and development fields.

The record since 2002

16. Noting that 70 per cent of the world's poor are female, with many involved in casual, temporary, migrant work or self-employment in food and agricultural sectors, the 2007 IUF Congress expressed concern that such fundamental rights as freedom of association, non-discrimination, maternity and social protection are absent or undermined and considered the effect of insecurity, low wages and irregular hours on family life. Hundreds of thousands of women workers lack adequate health and safety protection, with many accidents and illnesses never officially declared. Add to this gender-related violence, intimidation, sexual harassment and the fact that half a million women die annually from pregnancy-related complications exacerbated by poverty, remoteness, a lack of medical care and HIV/AIDS. Women also dominate the workforce in export processing zones that have a direct connection to the food and agricultural industry, which are beyond the reach of labour legislation and where trade unions are virtually non-existent. Many countries have yet to ratify the ILO Conventions on freedom of association, equal remuneration, discrimination, health and safety, maternity protection, workers with family responsibilities and home work, etc.

17. The Summit also called for an end to child labour and action to ensure that children can attend primary school, with access to all levels of education; for immediate and effective measures to eliminate the worst forms of child labour; for international cooperation to assist developing countries address child labour and its root causes in poverty; for measures to combat human rights abuses against young people; and for programmes to provide health, nutrition, education, literacy and poverty alleviation. It called on organizations to cooperate with ministries and organizations, with strategies for alternative employment opportunities, and to provide required training to young men and women.

18. Unfortunately, the record since 2002 shows little follow-through on Summit commitments, as levels of child labour remain high, with many condemned to the worst forms of work. ILO 2006 *Global Report: The End of Child Labour: Within Reach* shows 132 million children ages 5 to 14 years — almost half of all child labourers — employed in agriculture.⁵ Child labour is one of the most shameful features of a global economy in which dangerous and precarious work is transferred

⁵ *Global Report: The End of Child Labour: Within Reach*, International Labour Organization, (International Labour Office, Geneva, 2006).

from rich countries to the poor. It is particularly prevalent in Africa and other developing countries, disproportionately involving girls who are likely to work for long hours, in addition to homemaking and housekeeping tasks. Children in rural areas or in migrant worker families are twice as likely to be exploited this way, as many work alongside parents. ILO estimates that there are tens of millions of child slaves around the world, many working in agriculture. In some countries, child labour is fostered by explicit economic and social policies, and families sell children outright or bond them into slavery in order to pay off debts or simply to survive.

Box 4

A new partnership to eliminate child labour in agriculture

During the 2007 International Labour Organization International Labour Conference, IUF formed a partnership with ILO, FAO, the International Fund for Agricultural Development, the Consultative Group on International Agricultural Research (CGIAR) and the International Federation of Agricultural Producers to issue a Declaration of intent on cooperation on child labour in agriculture to conduct a broad programme of research, support and action to end child labour in this sector.

World Day against Child Labour

ILO dedicated 12 June 2007 as World Day against Child Labour, calling for a long-term, sustained commitment from Governments, employers, trade unions and civil society. Harvest for the Future: Agriculture without Child Labour calls on Governments to ratify ILO Convention 184 concerning Safety and Health in Agriculture. The International Food Policy Research Institute, representing the Alliance of the CGIAR Centres, confirmed its cooperation with other partners in efforts to eliminate child labour in agriculture. It supports 15 international research centres conducting groundbreaking work in support of policy solutions to cut hunger, malnutrition, and poverty (see www.ifap.org/en/newsroom/pr_childlabour_12-06-07.html).

E. Health and safety of workers linked to strong and accessible systems for public health

World Summit on Sustainable Development outcomes/trade union priorities

19. The Summit called for action to strengthen ILO/WHO programmes for occupational deaths, injuries and illnesses linked to public health; protect the health and safety of workers by, inter alia, taking into account the ILO Code of Practice on HIV/AIDS and the world of work; and link workplace measures to improved health services. It recognized the value of bipartite and tripartite mechanisms and greater access by workers and their representatives to training on the environment, safety and health, and economic and social welfare, and called on trade unions, employers, Governments and international agencies to involve workers and their representatives in ILO and WHO programmes to link occupational health with public health.

The record since 2002

20. Agricultural work is one of the three most dangerous occupations in the world (along with mining and construction), accounting for some 170,000 of the 330,000 work-related deaths annually and thousands more affected by injury or illness. The Summit intent was to utilize workplace programmes as a springboard to public health. The Commission at its sixteenth session therefore faces a number of issues, including the safety and security of food supply in a global climate where changes in ecosystems threaten the food supply and the health of millions.

21. Following the adoption by WHO in 2007 of a global action plan for workers' health, trade unions partnered with WHO, the International Commission on Occupational Health and the World Federation of Public Health Associations to improve occupational health and safety practices in the world's workplaces.⁶

22. Action is needed particularly to deal with unhealthy conditions in agriculture for workers who live where they work. WHO estimates that at least 40,000 people die annually from pesticides, with millions more severely poisoned in fields and homes. Agricultural workers are also first to be threatened by such new hazards as the highly pathogenic H5N1 strain of avian influenza, which raised alarm in 2007 about possible mutation into human transmission. However, most countries have yet to ratify ILO Convention 155 concerning Occupational Safety and Health or 2001 ILO Convention 184 concerning Safety and Health in Agriculture. Workers' rights are linked to working conditions, food safety and public health; as agricultural workers are in the best position to identify infection and contain outbreaks or to determine whether minimum food safety standards are being implemented. Although a proactive role by these workers and their unions could help restore confidence and public trust in food safety, few employers and Governments involve them in this way.

Box 5 Diacetyl

IUF calls for urgent global action on toxic food flavouring ingredient diacetyl to control the use of the food flavouring chemical that has been linked to the crippling lung disease bronchiolitis obliterans, or "popcorn workers lung", in the United States. Due to insufficient regulatory and labelling, however, the full extent of exposure is not known. Information on products and brands using diacetyl must be made readily accessible, and food workers' unions involved in a programme of comprehensive research into the hazards, including onsite monitoring, evaluation of production methods and protective measures and medical surveillance of workers at risk. Today's knowledge warrants an immediate suspension of the use of diacetyl pending a thorough appraisal of its workplace risks (see www.iuf.org).

⁶ See www.who.int/gb/ebwha/pdf_files/WHA60/A60_R26-en.pdf.

23. HIV/AIDS is a worker and workplace issue because it impacts on the health, jobs and security of workers generally, and because the workplace is well adapted to prevention and care. ILO statistics show that the epidemic is concentrated among people in their working years, as nearly 36.5 million people involved in productive work (a wider definition than "labour force") are HIV-positive.⁷ Over 70 per cent live in Africa,⁸ where some Governments have already reported that the pandemic is eroding their capacity to implement climate change adaptation measures, or to provide environmental and emergency services.

24. HIV/AIDS not only kills or debilitates, it reinforces a cycle of poverty, leading to loss of household income, reduced productive capacity, and growing personal, enterprise and national cost. For many of the working poor, sickness or injury often leads to job loss with no compensation or access to health care. A conference convened by French President Chirac in March 2006 concluded that health-care costs and indirect expenses were the single most determining factor driving people into poverty. More than a third (36 per cent) of the world population lacks access to any health service. Concern about the situation has grown in recent years, but when global initiatives are undertaken, workers' representatives have yet to be invited to the table.

Box 6

28 April campaign highlights HIV/AIDS

International Commemoration Day for Dead and Injured Workers, 28 April, is dedicated to workers killed, injured or ill because of unsafe, unhealthy and unsustainable workplaces and processes. Since the first International Commemoration Day ceremony at the United Nations in New York in 1996, the Day has grown to encompass thousands of rallies, sectoral, educational and lobbying events around the world. International Commemoration Day, 28 April, is now recognized formally by Governments in 14 countries or territories (Argentina, Belgium, Bermuda, Brazil, Canada, Dominican Republic, Greece, Luxembourg, Panama, Poland, Portugal, Spain, Taiwan and Ukraine. In addition, the Andean Community — Bolivia, Colombia, Ecuador and Peru — and associate member Bolivarian Republic of Venezuela have agreed to recognize the Day, which would bring the total number of countries recognizing the Day to 19. The International Trade Union Confederation has begun a process for eventual recognition of 28 April by the General Assembly. Country activities for 2007 can be seen at www.global-unions.org/pdf/ohsewpT_4a.EN.pdf.

25. The world today urgently requires more health-care workers, according to Public Services International and WHO, as more than 1.3 billion people lack access to basic care, with the greatest shortage in sub-Saharan Africa, which has 11 per

⁷ International Labour Organization, *HIV/AIDS and work: global estimates, impact and response 2006* (Geneva, 2006).

⁸ See Trade Union Country-by-Country Profiles for HIV/AIDS at www.tradeunionsdunit.org/profiles/profiles.php?ID=3&Lang=ENG.

cent of the world population and 24 per cent of the burden of disease, but only 3 per cent of the world's health workers. The *WHO World Health Report 2007* reports that more than 4 million additional doctors, nurses and other public health workers are urgently needed to fill the gap in 57 countries, 36 of which are in sub-Saharan Africa. Unfortunately, these countries are hardest hit by an out-migration of health-care workers. While trade unions support the right to migrate, the negative impact of this migration on health-care systems in developing countries, the majority of whom are women, has reached crisis proportions and must be addressed.

Box 7

Public Services International organizes international migration and women health-workers campaign

In December 2005, Public Services International called on affiliates to join a week of campaigning around the issues of ethical recruitment of health-care workers and the negative impact of migration on health services in sending countries. A 16-country network, established as part of the Public Services International Migration and Women Health Workers Project, invites all affiliates, particularly those with members in the health sector, to organize activities in their regions. As women are affected, both as health workers and users, women's committees are particularly involved. Public Services International has developed information materials, a model resolution and a leaflet about the importance of ethical recruitment for trade unions to use in their campaigns (for more information, e-mail equality@world-psi.org).

F. Employment transition as a fundamental precondition to implementation for sustainable development

World Summit on Sustainable Development outcomes/trade union priorities

26. Human insecurity, particularly job insecurity, can be brought on by changes that, more often than not, have left workers and their communities bearing the greatest cost. Without "just transition" policies and programmes, the inevitable result of job loss or dispossessed land holdings is increased poverty, social inequity and hardship. The Summit called for measures to promote the participation of workers and their trade unions in programmes for employment, industrial strategies, labour adjustment programmes and technology transfers, and recommended that international financial institutions and other agencies support developing country economies in transition, in their efforts to adjust to changes in energy and related technologies.

The record since 2002

27. Workers continue to face economic hardship or insecurity as a result of climate change and other drivers of change. Threats to traditional patterns of agriculture and food supply have grown exponentially since the Summit, affecting agricultural workers, small farmers and others who depend on these sectors, especially in developing countries. Trade unions have consistently lobbied for employment

transition programmes to provide an element of justice and build confidence and support for national efforts to address climate change. The trade union Nairobi Action Plan for Africa depends on the involvement of workers and their communities in climate change adaptation strategies that are especially required on that continent.⁹ Except for very few negotiated agreements with employers and Governments, a “just transition” remains a distant ideal. Governments and employers have yet to ensure that workers are able to adapt, to include as a minimum, adequate job forecast and skills management, a reconversion programme and income support programmes for workers in affected industries. Trade Union Country-by-Country Profiles shows that most countries have yet to ratify such ILO Conventions as Convention No. C-122 concerning Employment Policy or the ILO 1974 Resolution on the Social and Economic Consequences of Preventive Action, which calls for arrangements for social and economic consequences affecting workers.

Box 8

Decent work for sustainable development campaign

Decent work for sustainable development: the challenge of climate change, a paper for the Working Party on the Social Dimension of Globalization (GB.300/WP/SDG/1, Geneva, November 2007) focuses on socially just transition to green jobs and the relationship between climate change and decent work. The European Trade Union Confederation, SYNDEX, the German Wuppertal Institute and the Spanish institute ISTAS undertook their own study, financed by the European Commission, Belgium, Finland, France, Italy, Spain and the United Kingdom, which examined the potential impact on employment of the EU's carbon dioxide (CO₂) reduction targets concerning four key industrial sectors: energy production (electricity, oil), energy-intensive industries (steel, cement), transport, and building/construction; it concluded that there could be an overall net gain in employment identified with transfers to environmentally friendly forms of energy production and use. It warned, however, that jobs will be created only where companies take advantage of opportunities created by climate policies and lost where companies cannot adapt (see “Climate change and employment: Impact on employment in the European Union-25 of climate change and CO₂ emission reduction measures by 2030”).

28. Finally, a “just transition” to sustainable patterns of production and consumption cannot occur without changes to trading patterns that disadvantage developing countries. Development in industrialized nations has provided an inappropriate model for other parts of the world, particularly Africa. Developing countries struggle with negative terms of trade, crippling debt, and demands for structural adjustment that render sustainable development much more difficult.

⁹ Trade Union statement to COP 12 2006, available at www.global-unions.org/pdf/ohsewpP_8Ae.EN.pdf.

Box 9**ILO head promotes green jobs initiative as transition strategy**

According to ILO Director-General Juan Somavia, huge opportunities exist to create green jobs through energy and industrialization policies that reduce emissions as investments in energy efficiency, clean energy technology and renewable energy have great potential to create productive and decent work; the market for clean energy technology alone could be worth 1.9 trillion dollars by 2020, creating green jobs and sustainable economic growth. "We must also prepare for job losses and support workers and enterprises in shifting to new ways of working that substantially reduce emissions," said Somavia. "We also need to invest much more in low emissions strategies for development that do not slow progress in poverty reduction ... [to] ensure a smooth transition for all involved" (statement by ILO Director-General at the High-level Event on Climate Change, New York, 24 September 2007).

G. Energy, water and chemical inputs into the food and agricultural industry

World Summit on Sustainable Development outcomes/trade union priorities

29. Energy, water and other major inputs into food and agriculture industries are major issues for production and consumption and public utilities. The Summit called for the integration of all energy considerations, including affordability and accessibility, into all programmes, especially for such energy-consuming sectors as agriculture. It also called for research and development on reliable, affordable, economically viable, socially acceptable and environmentally sound energy for sustainable development, and for the development and implementation of integrated land management and water-use plans with strengthened capacity for Governments, local authorities and communities to monitor and manage these resources. It established priorities for access to potable domestic water, hygiene education and improved sanitation and waste management at the household level, with priority given to the needs of the poor, within stable and transparent regulatory government frameworks involving all concerned stakeholders to monitor and improve accountability of all service providers.

The record since 2002

30. Problems noted at the Summit in 2002 persist today, as productivity and profit priorities in food and agricultural industries overshadow environmental and social concerns. Environmental degradation from unsustainable practices is now at crisis levels from unsustainable patterns of energy, chemicals and water-related use, including increased inputs of pesticides, biomedical substances, fertilizers and toxic inputs; increased use and deterioration of water quality, loss of biodiversity, wildlife habitat and landscape; and lack of safe water for domestic purposes. Groundwater contamination from factory farms continues from unsafe use of pesticides and other synthetic inputs, as well as from manure in lagoons or on the land. The Sierra Club estimates that, as a result of contamination, 13 per cent of the drinking-water wells

in the American midwest contain unsafe levels of nitrates, as well as environmentally damaging amounts of phosphorus and antibiotics and air pollution from emission of hydrogen sulfide and ammonia. Researchers have found that farm workers and families living near animal factories show symptoms of respiratory, physical and emotional illness at levels significantly higher than other groups, as well as high levels of tension, depression, anger and fatigue.¹⁰

Box 10

North American coalition opposes intensive livestock operations

The Beyond Factory Farming Coalition is drawing attention to hazards posed by livestock operations in North America, where giant feedlots of 20,000 cattle, mega hog barns of 5,000 to 20,000 hogs, poultry batteries of 100,000 birds exist on small land areas, and under intensive conditions resembling manufacturing. Animals' feed is often grown far from these "factories" and manure is spread or sprayed onto fields in quantities that exceed the nutrient needs of crops, causing pollution to surface and ground water. Numerous toxic or pathogenic substances are found in drinking water around these farms: hog urine and feces, human waste, hog carcasses, cleaning chemicals, insecticides, weed seeds, volatile organic compounds, salts, nitrogen, phosphorus, potassium, calcium and manganese, metals (cadmium, zinc, nickel, lead, iron, boron and copper), vaccines, antibiotics and antibiotic-resistant bacteria, parasites, and other bacterial and viral pathogens such as cryptosporidium, salmonella and E-coli. The quantity of manure is itself an issue, as factories use millions of gallons of drinking water to flush manure out of the barns into lagoons or holding pits. Countries spend billions of dollars to treat human sewage, but the greater volumes of animal manure produced on factory farms receive little or no treatment (see www.beyondfactoryfarming.org).

31. Although electricity supply has been extended to 1.3 billion more people in developing countries in the last 25 years, 1.4 billion people still lack access according to the International Energy Agency, with the number reliant on biomass expected to increase to 2.7 billion by 2030. The World Health Organization has blamed exposure to biomass for nearly 2 million deaths from cancer, respiratory infections and lung diseases. As well, lack of access to energy provides a serious barrier to basic social goods like health care and education. The end of "cheap oil", moreover, means increased poverty for many, including recipients of debt relief under the Heavily Indebted Poor Countries initiative that are heavily dependent on their food and agricultural sectors. To this injustice can be added the fact that global dependence on fossil fuels is a major cause of the climate change that threatens lives and livelihoods, particularly in sub-Saharan Africa and Asia.

32. Although widespread privatization, deregulation and liberalization have slowed, they continue to affect food and agricultural industries, their workers and communities, particularly in Africa. Water and energy prices continue to rise in

¹⁰ See www.sierraclub.org/cleanwater/that_stinks.

some of the world's poorest countries, forcing households to spend a substantial part of their income for safe water and sanitation, and creating particular difficulties for girls and women.

Box 11

Public Services International

Public Services International, together with its research arm, the Public Services International Research Unit, conducts cutting edge research on issues relating to energy and water services and other utilities and services. A 2007 study on the Asian Development Bank's involvement in power sector privatization in Pakistan, "Water as a public service", shows how the international community can support Governments, public institutions and workers in developing countries to extend and improve water and sanitation services. As well, Public Services International published a report in collaboration with the World Development Movement, "Pipe dreams: the failure of the private sector to invest in water services in developing countries", which reviews investment in sub-Saharan Africa, South Asia and East Asia (dozens of related publications may be accessed at www.world-psi.org).

33. The Summit renewed the commitment in Agenda 21 to sound management of chemicals through their life cycle, to ensure minimal adverse effects on human health and the environment from their production and use; to using transparent science-based risk assessment and management procedures; and to taking into account the precautionary principle. It committed to partnerships and to helping developing countries strengthen capacity for management of chemicals and hazardous wastes, and to promoting ratification and implementation of international instruments on chemicals and hazardous waste, including the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade and the Stockholm Convention on Persistent Organic Pollutants. It also encouraged countries to implement the new globally harmonized system for classification and labelling of chemicals.

The record since 2002

34. The production and use of chemicals in agriculture and food is producing a growing number of environmental and human health problems. The highest level of exposure normally occurs in the workplace, but agriculturally dependent communities are also exposed to a "chemical cocktail" spread by wind or water. Ozone depletion, acid deposits, pollution of water, soil and air, and loss of biodiversity are by-products of improper uses of chemicals, particularly ones that are persistent, bio-accumulative and travel across boundaries. Participation by workers and their trade unions is crucial to proper management of chemicals, and even though participatory methods have yielded enormous public health and environmental benefits, they have yet to be recognized in most national policies. Such key notions as the precautionary principle, clean production, best available techniques, and best environmental practice have yet to be put into practice.

35. Trade unions have collaborated on such international agreements as the Strategic Approach to International Chemicals Management, and Conventions and Agreements under ILO, UNEP, on persistent organic pollutants, prior informed consent, greenhouse gases under the United Nations Framework Convention on Climate Change, the Intergovernmental Forum on Chemical Safety, and the Bahia Declaration on Chemical Safety. Good results are expected from the implementation of European Community Regulation 1907/2006 concerning the registration, evaluation and authorization of chemicals in the European Union.

H. Technological innovation in agriculture and other industries related to the themes of the sixteenth session of the Commission on Sustainable Development

World Summit on Sustainable Development outcomes/trade union priorities

36. Technological innovation is a primary area of concern for all consumers, but particularly for workers who come face to face with new products and processes that threaten their health and that of their communities. The Summit addressed genetically modified organisms and other innovations involved in the intensification of food and agriculture production and called for action to promote and finance access to and development and diffusion of environmentally sound technologies and corresponding knowledge, in particular to developing countries on favourable terms, as set out in Chapter 34 of Agenda 21. It also called for the participation of workers and their trade unions for policies and programmes on environment and development, including for employment, industrial strategies, labour adjustment programmes and technology transfers.

The record since 2002

37. The rapid and, for the most part, unregulated introduction of new technology into the world's food and agricultural systems continues to threaten the safety and security of our food supply, at the same time as it threatens the health of workers and the natural environment. Liberalized trading patterns buttressed by international agreements make it difficult for countries to protect themselves against inappropriate or dangerous innovations, or to set high food standards. Trade unions have documented threats posed by genetically modified organisms, and the countless hormones, medicinal additives and other substances daily introduced into our agricultural operations and food supplies. United Farm Workers of America (UFW) regularly reports on excessive drug residues in livestock that put farmworkers at risk. A UFW book, *California's Broken Promises: The Laws On The Books Are Not The Laws In The Fields*, reveals many of these problems.

Box 12

United Farmworkers of America has issued an alert concerning Beef Northwest Feeders, one of the largest American feedlots, which fattens approximately 40,000 cows a year as Country Natural Beef. The Food and Drug Administration has warned the company about excessive residues of two drugs that violate federal requirements. Sixty per cent of Country Natural Beef is sold through Whole Foods, a "natural food" store that claims ethical business practices. UFW has appealed to Whole Foods to ensure that the beef sold in their stores does not contain unsafe levels of drugs, and to stand by fieldlot workers who seek union representation (see www.ufwaction.org/campaign/beef).

38. Trade unions have negotiated numerous workplace-centred approaches mechanisms for occupational health and safety that can be readily adapted to technological change and food safety. Joint trade union/employer initiatives for assessment and implementation could address such outstanding issues as risk and hazard assessment and analysis/methodology in biotechnology, including public health risks; quality attributes for nutritional content; production methods and effective regulatory compliance; and support for the Codex Alimentarius.

Box 13**Food and agricultural workers' union kicks off food sovereignty campaign**

IUF, at its 2007 Congress, adopted policy defining the right of people to sovereignty in the production, distribution and consumption of food in order to guarantee sustainable food. The current liberal economic model is forcing countries, once self-sufficient in food, now to import agricultural products. Export-oriented monocultural agro-business encroaches on public land occupied by traditional populations and family farmers, and the mass planting of the African palm and eucalyptus in Latin America, Asia and Africa, as well as sugar cane, palm and soya for bio-fuels, destroys jobs, degrades the environment, exhausts natural resources and destroys family farming. IUF will support the fight for agrarian reform to preserve family farming and pursue decent standards of living and working conditions. As well, the Alternative Project for Sustainable Mutual Rural Development will bring farmers' and farm workers' organizations together to draw attention to the impact of plantations on work and society.

III. Moving forward with workplace action and agreements

World Summit on Sustainable Development outcomes/trade union priorities

39. As presented in chapter 29 of Agenda 21, workers and their organizations possess tremendous capacity for sustainability. The Summit called for the removal of barriers to worker engagement and positive steps towards participation and empowerment, on the basis of decent employment. It called for good industrial relations and partnerships to strengthen the contribution of workplace relations towards sustainable development, including a role for unions in addressing industrial change with environmental collective agreements aimed at achieving sustainable development. Numerous references are made to joint or tripartite mechanisms at the workplace, community and national levels to deal with safety and health, and to promote workers' freedom of association according to ILO Conventions, which Governments are encouraged to ratify and implement. A central theme of the Summit was the focus on "Partnerships", including workplace-based partnerships and programmes, to promote transparency and accountability and information tools (e.g., eco-labels) that reflect human health and safety aspects.

The record since 2002

40. Unfortunately, the record shows that, far from following through with the Summit commitment to good industrial relations, many nations have moved in the opposite direction. The casualization and globalization of employment have reduced worker access to trade union representation. More drastically, the 2007 *Annual Survey of violations of trade union rights*, compiled by the International Trade Union Confederation, documents an alarming increase in the number of people killed because of trade union activities, from 115 in 2005 to 144 in 2006, with the sharpest increases in Colombia, Asia and Africa. Thousands were arrested for participation in actions to protect workers' rights, and many thousands more faced direct intimidation or dismissal. A number of industrialized countries have also moved to further restrict trade union rights.¹¹

41. Workers continue to assert their rights, with information and support for organizing precarious work and educational resources, such as the recent IUF manual, *Outsourcing and Casualization in the Food and Beverage Industry: Threat to Workers and Unions*. Dialogue is the basis of over 2 million collective agreements negotiated by trade unions worldwide, which are supplemented by European Works Councils and the Framework Agreements that provide a platform of standards that a multinational company must apply wherever it operates. One of the earliest in the food industry was a 2001 agreement between IUF and Chiquita Brands International, the largest employer of banana workers in Latin America.¹² As well, a proven industrial relations mechanism is the workplace committee for environment and occupational health, whose primary mandate is to educate members and participate in planning and monitoring for improved company performance. The Summit also saw a role for workplace assessments whereby trade unions and employers jointly assess workplace performance according to agreed checklists of environmental, resource, occupational, health or social criteria, leading to joint plans of action to identify and resolve problems.

¹¹ See Human and Trade Union Rights at www.ituc-csi.org.

¹² See www.ituc-csi.org.

Box 14**Swedish truckers to perform workplace supply chain assessments**

Trucking and transport companies in Sweden are participating in nationwide supply-chain assessments that will determine successful bids for transport or shipping contracts. The national Swedish Labour Organization and the National Society for Traffic Safety have agreed with more than 100 Swedish retail and manufacturing companies, a major component in the food and agricultural system, to take part in Quality III to evaluate transport contract bids based on their performance relative to environment, traffic safety and gas emission indicators detailed in a manual for this purpose. It will award a Quality III certificate, which a growing number of retail and manufacturing companies have agreed to honour, thus shifting the burden of responsibility from the truck driver to the trucking companies. Quality III will scrutinize a company's air pollution, fuel mileage, vehicle performance and maintenance, as well as workloads, health care, ergonomics and work management, speed policies, equipment safety and supervision, etc. (for more information, contact Lasse Holm: lasse.holm@Q3.se):

42. Since the Summit, trade unions have increased their capacity for training and information systems developed for occupational health and safety that are based on democratic forms of worker participation, which are being adapted for agricultural workers, farmers, communities and consumers. As well, initiatives in vocational training, improvement of skills and lifelong learning, such as the 2002 European Agreement on Vocational Training in Agriculture, are equipping workers to adapt to changing conditions, as well as contributing to improved economic performance. Such instruments as enterprise assessments/audits and eco-labels also have an educational impact, at the same time as they meet Agenda 21 objectives in the workplace.

Global and regional alliances

43. Many of the issues of the Commission's sixteenth session review can be linked to deepening globalization, which calls for a collective global response. Trade unions have never subscribed to the popular idea that globalization has rendered nations powerless to serve the needs of their citizens, and continue to see the State as playing a central role in providing such services as education and health care, etc. In this regard, we note that the Summit called for a stronger role for Government by taking action at all levels to promote corporate responsibility and accountability, on the basis of the principles of the Rio Declaration on Environment and Development.¹³

¹³ A/CONF.151/26 (vol. I), annex I.

Box 15**German trade union promotes sustainable development through joint projects**

German trade unions undertook one of the world's first sustainable development initiatives when they launched their Confederation eco-audit in 1994. The Confederation of German Trade Unions (DGB) worked together with such environmental organizations as the Association for Environment and Natural Preservation (BUND), the Nature and Biodiversity Conservation Union (NABU) and the World Wildlife Fund (WWF) to establish an ecological audit that was independent from industry employers. A successful environmental initiative for sustainable forestry was undertaken by IG BAU. The trade union for construction, agriculture and environment workers was jointly responsible for founding the Forest Stewardship Council in Germany, the first organization to develop a certification system for sustainably produced wood. The Forest Stewardship Council promotes appropriate forest management all over the world, with close attention to the balance between ecological, social and economic demands of forestry.

44. Trade unions continue to pursue strategic alliances with business and other Major Groups, as well as national and sectoral initiatives. A 2005 agreement between the Spanish Government, the Confederación Sindical de Comisiones Obreras, the Unión General de Trabajadores and leading business organizations calls for collaboration on national efforts to meet Kyoto obligations, with attention to social and employment impacts. Agreements also exist between the Government and the Confederación General del Trabajo in Argentina, and in Belgium, the Government has geared its approach to "flexible mechanisms" under the Kyoto Protocol to social and employment policy, dictating that project proposals must apply the principles of the OECD Guidelines for multinational enterprises, ILO Conventions and the Declaration on Fundamental Principles and Rights at Work. Trade unions monitor projects to ensure that essential services are delivered to local populations, and for environmental, social and economic impacts.

Box 16**IUF intervenes in key European pesticide regulation vote**

Pesticide regulation in the European Union not only impacts the lives of workers in one of the world's largest agricultural economies, it also affects global practices. For this reason, IUF intervened regarding the vote on the EU Thematic Strategy on the Sustainable Use of Pesticides in October 2007. A proposed EU Regulation for plant protection products and a Directive for sustainable use of pesticides will define a regulatory framework for agrochemicals for years. In an open letter to members of the European Parliament, IUF general secretary Ron Oswald and European Regional General Secretary Harald Wiedenhofer called for assurance that human and environmental health will govern pesticide authorization, that the most toxic pesticides be eliminated or reduced, and that authorizations be based on comprehensive evaluation (see www.sustainlabour.org).



Economic and Social Council

Distr.: General
10 January 2008

Original: English

Commission on Sustainable Development

Sixteenth session

5-16 May 2008

Item 3 of the provisional agenda*

Thematic cluster for the implementation cycle

2008-2009 — review session

Discussion papers submitted by major groups

Note by the Secretariat

Addendum

Contribution by business and industry**

Contents

	<i>Paragraphs</i>	<i>Page</i>
I. Overview	1-3	2
II. Introduction	4-10	2
III. Priorities and challenges	11-26	3
IV. Agriculture, rural development, land	27-41	8
V. Drought, desertification and climate change	42-51	14
VI. Africa	52-66	17

* E/CN.17/2008/1.

** The present paper was prepared by the International Agri-Food Network (IAFN) (www.agrifood.net). IAFN brings together international-level associations and federations whose members are suppliers of agricultural inputs and raw materials, individual and family farms, cooperative organizations, food processing and transport businesses, small and medium-sized enterprises through to multinational corporations. IAFN has sought input from the wider business community through networks such as the International Chamber of Commerce, the World Business Council for Sustainable Development and Business Action for Africa. This paper does not represent an official position or statement on behalf of IAFN or the other groups cited. The views and opinions expressed do not necessarily represent those of the United Nations.



I. Overview

1. Despite great success in raising agricultural productivity over the past half-century, world cereal stocks are at their lowest level in more than two decades. It is estimated that by the year 2030, the world population will have increased by about 1.5 billion people to reach some 8 billion people. In addition, rising incomes, especially in China and India, are driving the consumption of more meat, with associated higher resource requirements. This, combined with strengthening trends to use crops for non-food purposes, will further increase the imperative to raise agricultural productivity.
2. At the same time, pressure on natural resources — such as water, soil and biodiversity — is increasing dramatically. Extreme weather events are more frequent as a result of climate change, which is also the impetus to develop carbon-neutral fuels. To ensure environmental health and avoid further encroachment onto wildlife habitats, agriculture must balance multiplying demands and further increase the productivity of existing farmland by reducing losses and increasing yields through innovative agricultural techniques and good management practices. A globally sustainable system will comprise a mosaic of site-specific solutions that does not exclude a priori any option.
3. Agri-food businesses contribute to this objective by providing new innovations and supporting research on the best way to integrate them into the overall production system. The examples described in this paper give a taste of the many business initiatives worldwide, which, through lower prices, raise the quantity, quality and diversity of available food and safeguard the environment.

II. Introduction

4. Responding to the invitation to provide business and industry perspectives on the thematic areas of the sixteenth session of the Commission on Sustainable Development, this document identifies key issues and examples of successful implementation, ongoing barriers and obstacles, lessons learned and best practices emerging since the Commission focused on agriculture at its eighth session, in 2000.
5. Business and industry share the view that progress in this cluster is fundamentally important to achieving the Millennium Development Goals and to sustainable development. The urgency of challenges in agriculture and rural development is increased by the number of people who remain undernourished or malnourished and by continuing land degradation, drought and desertification; declining water supplies and soil fertility; and loss of biodiversity. Many of these are aggravated by climate change, particularly in Africa.
6. Social and economic dimensions must be addressed within an integrated, balanced and multi-stakeholder approach, based on sustainable development. It is in the interest of business and industry to work in partnership with Governments and other stakeholders to catalyse action to reduce hunger and poverty, to promote sustainable agriculture and rural development and to support sustainable management of land resources.
7. One of the first indicators of sustainable agriculture must be its ability to provide sufficient quantities of high-quality produce. In order to achieve this goal in

a way that ensures environmental health and profitability for farmers, agriculture and all stages of the agri-food chain must be as efficient as possible, using inputs optimally and minimizing waste.

8. While the Commission also reviews its decisions on water and sanitation taken at the thirteenth session of the Commission on Sustainable Development, business and industry reaffirms its view that improving basic access to water and sanitation is a crucial component of rural development. Integrated water resources management is essential to enhance agricultural productivity and sustainable management of land resources. In linking the review of the implementation of the thirteenth session of the Commission on Sustainable Development water and sanitation decisions to its thematic reviews at the sixteenth session of the Commission on Sustainable Development, the business and industry sector also refers delegations to its background papers for both the eighth session of the Commission on Sustainable Development and the thirteenth session of the Commission on Sustainable Development.¹

9. Business and industry support and participate in the sustainable agriculture and rural development initiative that emerged from the eighth session of the Commission on Sustainable Development and was officially launched at the World Summit on Sustainable Development held in Johannesburg in 2002. They reaffirm their support for the overarching objective of sustainable agriculture and rural development to increase food production and enhance food security within a framework of sustainable natural resource management. It is important to build the capacity of poor rural communities to become aware of, and adopt, good practices that facilitate the transition to sustainable agriculture and rural development.

10. The Commission is encouraged to recognize and address the dramatically changing agricultural context — population and income growth, changing consumption patterns and market frameworks, rural-urban migration, climate change and other aspects of the declining availability of natural resources. It is imperative for all stakeholders to assume their responsibilities and take priority actions to raise agricultural efficiency and effectiveness.

III. Priorities and challenges

11. Since the eighth session of the Commission on Sustainable Development, which focused on agriculture and rural development, many examples of progress in social, economic and environmental terms have achieved improved soil management techniques and technologies to reduce erosion and pest impacts; the use of integrated farming techniques; the protection of biodiversity through sustainable intensification of land; the development of seeds with improved quality traits, higher yields or stress-tolerance; reduced waste of foodstuffs through judicious use of pest controls and improved storage and distribution systems; refined agro-forestry systems; improved water management and so on.

12. However, we are working towards a moving target. Climate change amplifies many issues, making it even more important for Governments, civil society and business to work together actively. The World Bank's *World Development Report 2008* asserts that agriculture is a fundamental instrument for sustainable

¹ www.un.org/esa/sustdev/documents/docs_sdissues_major_groups.htm.

development and poverty reduction. Business and industry welcome the conclusion that using agriculture as the basis for economic growth in the agriculture-based countries requires a productivity revolution in smallholder farming, and that to achieve this, the maintenance of agricultural resources is a global imperative.

A. Demographic trends are squeezing rural labour and agricultural land

13. Changing consumption patterns entail more diversified diets, including more fruits, vegetables and meat, all of which affect the use of natural resources such as water, nutrients and other inputs and accelerate the growth of agricultural demand.

14. The United Nations Population Division has calculated that 2007 marks the first time that more of humanity lives in urban areas than in rural areas. Migrants to cities — often people in their physical prime — are unavailable for rural labour, so farmers must become more effective. These factors are exacerbated by the impact of disease, especially in Africa, and the spread of cities onto fertile farmland.

B. Multiplying demands are being made on a finite resource base

15. What little additional arable land is available to bring under cultivation is often poorly served by existing infrastructure and markets, reducing short-term prospects for expanding farmland. Water supplies are subject to competing demands. Yet, in addition to the need for more food and more varied diets, there is growing interest in using agriculture for non-food purposes. According to recent figures from the United States Department of Agriculture and Food and Agriculture Organization of the United Nations, the global stock-to-use ratio of cereals is at the lowest point in more than two decades and equivalent to well under two months of consumption.

16. Increasing productivity on existing land is more favourable to the environment and less demanding on global resources than expanding into uncultivated areas. The integration of appropriate traditional methods and modern agricultural technologies along with site-specific best management practices allows farmers to increase production per unit area. Fragile ecosystems can thus be protected and natural habitats preserved.

C. Improved crops have long helped improve agricultural productivity

17. New crop varieties, whether developed through traditional breeding or through green biotechnology, help farmers to increase productivity on already ploughed land. In addition to enhancing crop yields or quality, breeding can also target specific attributes, such as producing canola with fewer trans fatty acids or fibre crops with longer fibres.

18. Plant breeding primarily aims to produce vigorous plants that will fulfil their quality and yield potential. Such enhancements — coupled with other technological improvements — were demonstrated by the rice and wheat varieties that formed the basis of the green revolution. Their yields have increased 20-30 per cent on average since the 1970s. Similarly, studies released in 2002 by the Washington-based National Centre for Food and Agricultural Policy concluded that the widespread

adoption of six biotechnology-enhanced crops increased farmer income, boosted yields and spurred greater use of no-till agriculture.²

D. Pre- and post-harvest losses reduce agricultural output by about half

19. A significant challenge persists due to losses to pests and diseases which average around 35 per cent from pre-harvest pests and 10-20 per cent post-harvest. Losses in the developing countries of Africa, Asia and Latin America — precisely those areas where agriculture is the most crucial economic activity — are considerably higher than in industrialized countries and in some exceptional seasons even reach 100 per cent. It is now generally accepted that optimal pest management integrates a range of activities — from growing a healthy crop which is more able to withstand pest attack and creates conditions suitable for natural enemies, to the use of modern pest control chemicals and biotechnology.

E. A coordinated effort is needed to bridge the productivity gap sustainably

20. The required gains in productivity will require a coordinated approach across agricultural value chains — including retailers, marketing, manufacturing and processing, distribution, transport, crop protection, seeds, livestock, fertilizers, biofuels and industrial crops, forestry, etc. — and with farmers, Governments, non-governmental organizations and other stakeholders. The private sector is a major provider of technology and innovation throughout the agri-food chain and also strives to ensure that farmers have the information to optimize the output from their crops and livestock in the most environmentally and socially acceptable manner. However, the private sector alone does not have the resources to ensure universal uptake of the most sustainable practices for all sites. Governments need to support agricultural development through infrastructure development, research and development and appropriate regulatory frameworks, among others.

21. The sheer scale of agricultural production today has strained natural cycles. For example, of the 2 per cent of freshwater withdrawn for human uses, some 70 per cent is for agriculture. The weight of this sector's demand for freshwater is keenly felt, particularly in areas where local water supplies are already limited. It is imperative to improve the efficiency of water use in order to achieve more output per drop.

22. Nutrients also present challenges for managing scarcity and excess. The nutrient needs of crops outstrip the availability of organic materials in many places. Land degradation and desertification in Africa, for example, are intimately linked with the loss of massive quantities of soil nutrients. Micronutrient deficiencies have high costs in terms of both agricultural losses and human health and well-being. Such deficiencies are one of the major contributing factors to diseases and often have a detrimental impact on human development.

² www.ncfap.org/whatwedo/biotech-us.php.

23. Nutrients, especially nitrogen and phosphorus, are accumulating in other places. The fertilizer industry has joined the United Nations Environment Programme Global Programme of Action for the Protection of the Marine Environment from Land-based Activities and many other institutions in a global coalition to address this problem.

Box 1

Case study. Turning lost nutrients into feed grass

Livestock is a significant contributor to global greenhouse gas emissions, especially in New Zealand. A compound developed by Lincoln University scientists, when applied to urine patches in pastures, helps prevent the formation of these gases and nutrient leaching and holds potential for other temperate zones. Keeping nutrients in the soil improves pasture growth and provides an inexpensive form of additional feed. Commercialized by Ravensdown Fertiliser Co-operative Limited, the product is expected to dramatically reduce New Zealand's emissions while also reducing nitrate run-off into watercourses by between 30 per cent and 60 per cent. Many farmers have already adopted the technology, but some hesitate because it is not yet known whether farmers will get credit for being early adopters when the Government brings agriculture into its emissions trading scheme in 2013. This underscores the importance of a predictable regulatory framework (see www.ravensdown.co.nz/Products/Eco-n/Default.htm).

Box 2

Case study. Zinc fertilizer boosts yields and public health in Central Anatolia

Zinc deficiencies were identified in the early 1990s as reducing wheat yields in Central Anatolia (Turkey). Toros Agri Industry and Trade Company made zinc-enhanced compound fertilizers available to farmers at the same price as those containing just the three main plant nutrients. Convinced by the results in their fields, Turkish farmers significantly increased the use of the zinc-fortified fertilizer per year within a few short years, despite the repricing of the products to reflect the added-value of the zinc content. In addition to the agronomic benefits that have been evaluated at \$100 million per year, this approach has also reduced zinc deficiencies in the local population. Zinc is essential for cell growth and division, fertility, a strong immune system and healthy eyes, skin, hair and nails. Almost half of the world's cereal crops are deficient in zinc and one third of the global population is at risk of lacking this key nutrient (see www.fertilizer.org/ifa/news/2007_13.asp).

F. Achieving optimal efficiency requires the right enabling market and policy frameworks

24. Infrastructure for transport and information, appropriate credit and insurance to reduce risk, reliable supplies of raw materials, functioning markets for both the inputs farmers need and the outputs they produce, as well as agricultural support networks (extension agents, crop advisors, etc.), are all important to foster agricultural development.

Box 3

Case study. Serving farmers by reducing credit risks for agrodealers

CNFA, a Washington-based non-profit that promotes public-private partnerships for development, established credit insurance in 2001 in Malawi to guarantee repayment of half of the money borrowed by agricultural input retailers to stock their shops. This greatly expanded the number of rural distributors and decreased the distances farmers travelled to obtain inputs, sometime quite dramatically, resulting in savings in both time and travel costs. By 2005, retailers covered by the guarantees earned more than \$1 million (plus a significant amount not underwritten by the credit insurance). Their success boosted local economies, raised Government tax receipts and increased the provision of non-agricultural services.

After the 2005 food crisis, the Government distributed seeds and fertilizers in order to prevent the situation from worsening. The 2006 maize crop rebounded significantly, but the impact on private-sector retailers was devastating: commercial sales of fertilizers slumped by 60-70 per cent. A coalition engaged with the Government to transform the support programme into a private-public partnership. Retail sales have since recovered. CNFA recently received a major grant from the Alliance for Green Revolution in Africa (the coalition of the Rockefeller and Gates Foundations) to expand its credit guarantees in Kenya, Malawi and Tanzania (see www.cnfa.org).

25. The economic and trade policy context influences agriculture strongly. Structural adjustment programmes in the 1980s and 1990s led to underfunding and sometimes the collapse of Government extension services. The assumption was that the private sector would fill the gap, but the right policy environment — including appropriate and enforceable regulation, protection of intellectual property and carefully considered market interventions — was lacking. Moreover, this assumption overlooked the fact that both the private sector and the public sector have complementary roles to play.

26. Although it is imperative for the current round of World Trade Organization negotiations to create new market opportunities for farmers and rural entrepreneurs, the majority of farmers in developing countries, and especially those in Africa, who farm at a subsistence level, are currently unable to benefit from new trade

opportunities. One major contributing factor to this situation is the lack of access to appropriate inputs, information and an appropriate domestic policy framework.

IV. Agriculture, rural development, land: efficient and productive agriculture is the key driver of rural development and a critical lever for sustainable land management

27. Among low-income countries there is heavy reliance on the export of agricultural goods and primary commodities, which are generally subject (metals and minerals notwithstanding) to lower and more volatile prices than those of manufactured goods. Yet, in many developing regions, particularly in Africa, much agricultural production remains at the subsistence level, due to a lack of access to affordable inputs (including credit), technologies, information and markets.

28. In very poor areas, there is little excess production for international trade, even if farmers could transport their goods to market and produce them at levels of cost and quality to make them competitive in global markets. However, even in the poorest communities, agriculture drives economic and social development. Agricultural production therefore merits much greater support from the international community and national Governments as a primary means to alleviate poverty.

29. In a virtuous circle, broader economic development in turn supports the agricultural sector because it fosters demand for farmers' goods, as well as driving the development of infrastructure, stable policy frameworks, governance and institutions, among others, that all improve the functioning of agricultural markets and increase the efficiency of production systems.

30. The lack of appropriate tenure in many developing countries serves as a disincentive to maintain and improve agricultural land. The result is often pressure to overexploit land or to encroach on marginal and/or sensitive areas. However, land tenure is just one factor. Another important incentive is the appropriate valuation of ecosystem goods and services so that farmers are rewarded and not penalized for good management. In the absence of proper incentives, valuable ecosystem services such as biodiversity and water filtration may be threatened.

Box 4

Case study. Beating poverty with milk while linking rural and urban economies

With its high-quality milk, Nairobi-based Brookside Dairy has a 40 per cent share of the Kenyan dairy market. Seven per cent of its 80,000 suppliers are commercial farmers and the remainder are small-scale producers. The widespread lack of refrigeration facilities means that Brookside employs an army of delivery personnel, including more than 1,000 "bicycle boys" in the Nairobi area alone, to collect milk. Its sales depots now stretch from the East coast to the shores of Lake Victoria in the West.

Brookside's training field days, each attended by up to 6,000 local farmers, help spread best practices in livestock management and provide networking opportunities for smallholders, many of whom are geographically isolated. The business links rural and urban economies and offers a sustainable route out of poverty for many. Additional benefits to local communities are health education programmes and funding for school, church and road building projects.

Box 5

Case study. Providing incentives to source raw materials locally

SAB Miller, one of the world's largest brewing companies, sources local crops through guaranteed purchase agreements with thousands of subsistence farmers in Uganda and Zambia. To qualify for lower excise duties in Uganda, its subsidiary Nile Breweries began using the locally grown sorghum variety Epuripur, for its Eagle Lager. This highly successful public-private partnership increases farmers' incomes and provides an additional source of tax income by shifting consumption to legally sold beer. Eagle Lager achieved a 20 per cent market share in just four years. Nile Breweries plans to spend \$1 million on sorghum — 60 per cent of which will go to the farmers, with the other 40 per cent spent on transport, procurement and processing (see www.sabmiller.com/sabmiller.com/en_gb/Our+responsibility/).

31. Market access and intelligence is critical for farmers, and new technologies, even in remote rural communities, are connecting farmers to timely market information and financial facilities as well as reducing transaction costs. The use of mobile phones and the Internet (even e-commerce and e-banking), represents leaps in efficiency, market access and profitability, while reducing waste, transport costs, etc.

Box 6

Case study. Kiosks for farmers

The Agricultural Information Network in Thailand, Agventures, in India, and Agri-Business Information System, in Jamaica, all aim to enhance the living standards of farmers by offering market prices, weather reports and farming best practices, which help improve labour productivity, increase yields and ensure better prices for produce.

To overcome low literacy rates and limited connectivity, some projects also provide "mediated access" through kiosks. For instance, through its e-Choupal kiosks, agri-exporter ITC Limited in India is building an internationally competitive agriculture business by empowering independent small farmers. EID Parry, an agricultural company in the Indian state of Tamil Nadu, has set up a network of "Parry's corners" through which farmers can access its India Agriline portal and e-commerce platform. The state of Karnataka is doing the same through its Raita Mitra Yojane project. The "Business intelligence

trade points" project in Burkina Faso provides access to market information through both national and regional centres. A similar hub-and-spoke system consisting of central and satellite agricultural information centres has been set up in Jamaica. In Bangladesh, a boat-based telecentre provides agricultural information to farmers located in areas inaccessible by roads.

Box 7

Case studies. Dial "A" for agricultural markets in Africa

The West Africa Agric Trade Network (www.tradenet.biz) provides information on the latest available prices from selected agricultural markets, buy and sell, news, contacts and other information required for commercial decision-making in all 15 member countries of the Economic Community of West African States. Farmers can receive all this information via text message on their mobile phones. The Trade in Hand project provides daily price information for fruit and vegetable exports in Burkina Faso and Mali, while Manobi, a Senegalese telecom company, provides agricultural and fish price updates to subscribers.

Safaricom, the Kenyan mobile phone operator, provides a text message service for farmers to access updates on commodities in markets direct from the Kenya agricultural commodity exchange. Traders can offer their goods for sale or place bids, as well as post short messages or questions on agricultural matters. Rural-based market information points help to extend the service to those farmers with limited access to mobile phones or computers.

32. Participatory approaches are required for long-term success in integrating traditional and local knowledge, new technologies, local inputs and appropriate infrastructure in order to achieve sustainable increases in productivity. In order to be more effective economic actors, it is useful for farmers, agri-input distributors and feed producers to organize into community groups that can negotiate more favourably for their members or even lobby policymakers for the right regulatory environment. Such groups may also dilute credit risks or obtain more affordable insurance.

Box 8**Case study. Sustainable agriculture and rural development initiative resource facility and online good practice database**

The web-based sustainable agriculture and rural development initiative resource facility and online good practice database provides a vehicle for sharing the experiences of implementing communities and support groups, and communicating lessons learned to decision makers at higher levels. Facilitated by FAO Headquarters in Rome, the database offers stakeholders a way to record and share local good practices (see www.fao.org/SARD/en/init/2224/index.html).

Box 9**Case study. Landcare International**

Landcare International is an association committed to the widespread application of a community-based approach that develops and applies innovative solutions to land management challenges, linking farmers with the broader community and helping them influence policy. Landholder groups initiate collective action to address land degradation and resource management issues, supported by Government programmes, such as AusAID, and the private sector, to back up local actions. Focusing on appropriate technologies, partnership development and institution-building, Landcare International has promoted similar initiatives in a growing number of countries, including Fiji, Germany, Iceland, Kenya, New Zealand, Philippines, South Africa, Sri Lanka, Uganda, United Republic of Tanzania and United States of America (see www.landcareinternational.net).

A. Technology, science and innovation are vital to achieve sustainable agriculture

33. Over the past 40 years, significant increases in productivity of the world's major crops — ranging from a 136 per cent increase in wheat yields (expressed as kilograms/hectare) to a 42 per cent increase in cassava yields — have more than kept pace with population growth. Productivity increases have been most dramatic in those regions of the world that have had access, and the opportunity, to adopt and adapt new technologies, integrating them with traditional methods that are suited to the particular conditions of a region. However, because land, labour and water are under pressure, it is critical to harness the human ingenuity expressed through improved management practice and innovative technologies. These include high-yielding crops adapted to difficult growing conditions (whether through traditional breeding methods or state-of-the-art techniques), crop protection products, improved crop nutrition and cutting-edge animal nutrition, among others. Stewardship and training are essential to fully realize the benefits of these technologies, and to

minimize any associated risks. For example, the plant science industry follows a life cycle, stewardship approach to managing its products — promoting good practices, from research and development, through field use, to disposal of any resulting waste, and working with Governments, non-governmental organizations and others to train farmers on the use and integration of appropriate technologies and inputs.

34. Computer-based information systems and precision tools are increasingly being adopted to operate farms more efficiently and to spare natural resources. For instance, the periodic occurrence of pests, plant diseases and weeds can be monitored and predicted. Weather models and accurate forecasts help to ensure that optimal use is made of natural resources, despite extreme weather events that can negatively affect the quality and yield of crops. This increases economic benefits for farmers and ensures yields of affordable and high-quality food and non-food crops.

35. Although precision farming is viewed by many as the reserve of big agribusiness operators, there are other, simpler precision methods that can be used by small-scale farmers too. One example is targeted pest-management through seed treatment. Treating seeds, rather than the whole field, reduces the amount of product applied by 95 per cent, targets only pests and safeguards beneficial insects in the vicinity. Another example is insect-resistant crops, which also spare beneficial insects. Both approaches save labour, water and fuel and have been used by small-scale farmers as well as on bigger farms. With regard to nutrient management, precision techniques have been adopted by thousands of farmers across Asia using the Leaf Colour Chart developed by the International Rice Research Institute. This chart employs the same principle as sophisticated chlorophyll meters employed by larger-scale farmers.

B. The critical role of integrated farming and ecosystems management

36. Because the most sustainable methods of production are site-specific, farmers should have the possibility to tailor their activities, drawing on a wide array of knowledge, experience and technologies. The integration of organic and mineral sources of plant nutrients, the adoption of suitable animal husbandry techniques, adapted plant varieties and integrated pest management systems are some of the components of the modern, knowledge-intensive approach to sustainable agriculture, which is often called integrated farming.

37. Sustainable farming approaches need to take account of local, site-specific conditions, varying climatic conditions and geography, access to markets, consumer demands and other factors. In general, it is a false choice to oppose modern techniques to traditional methods. Integrated farming systems that combine a mixture of both within site-specific good agricultural practices demonstrate the greatest potential to achieve productivity, efficiency and economy, while providing the social and environmental benefits sought by society. Specific challenges and priorities, such as soil fertility and water management, access to markets and lack of infrastructure and credit limit farmers' ability to choose the best practices. Therefore, Governments should invest in agriculture and provide the necessary market and policy frameworks to overcome these limitations so that agriculture can act as a catalyst for the development of other sectors of the economy.

38. Integrated management is now a fundamental component of both responsible crop production and livestock husbandry. The farm support industries and food

retailers³ focus on working with farmers and other rural stakeholders to develop and disseminate technologies and farm management practices to ensure an integrated and holistic approach to farming. Within the framework of integrated crop management, the protection of natural habitats within the farm environment is recognized as a means of conserving biodiversity, including many natural enemies of pests. Techniques include field margins or field levees (in the case of rice), as well as beetles banks or hedges. These islands provide habitats, cover and refuges for beneficial insects and other animals, thus contributing to the goal of the Convention on Biological Diversity to establish a network of connecting corridors of wildlife habitats to ensure biodiversity conservation at a landscape level.

39. Options that fit into integrated pest management include biological, mechanical and chemical crop protection measures as well as insect-resistant crop varieties. Modern pest management is based on prevention, careful monitoring of crop health (pressure from disease, weed and pest populations) and expedient interventions. Natural control processes — such as crop rotation and encouraging beneficial pest predators — also help to avoid outbreaks. The crop protection industries are strongly committed to developing, promoting and implementing integrated pest management technologies and practices at all levels.

40. Integrated plant nutrition management, which enhances soil productivity through the balanced use of mineral fertilizers combined with organic sources of plant nutrients, is supported by FAO and the fertilizer industry. To replenish nutrients removed by crops, farmers should begin by recycling on-farm sources of nutrients and then correct any deficiencies by using fertilizers. Although the recycling of available organic material (plant and animal residues) is a desirable feature of all farming systems, helping to retain moisture and build soil structure, it is now recognized that recycling alone rarely provides adequate nutrients for sustained, productive cropping.

Box 10

Case study. Conservation tillage helps prevent soil erosion and water loss

Conservation tillage, where seeds are sown directly into the previous crop's stubble without any immediate tillage, protects land from wind and water erosion, and loss of ground moisture. It results in higher levels of soil organic matter, enhanced soil aeration, preservation of soil structure and soil fauna, as well as lower fuel/labour requirements. Conservation tillage is enabled by herbicides and has reduced erosion by up to 95 per cent in many areas. A typical example is a farm in the United States of America with increased levels of over 50 per cent in soil organic matter from 2.7 to 4.3 per cent, with some fields reaching 6 per cent (see www.fao.org/News/2000/000501-e.htm).

³ www.globalgap.org.

41. Integrating ecosystem management approaches in mainstream agriculture will contribute to sustainable agriculture on a global scale. Rather than being based on arbitrary input reductions or on extensive production systems that require more land, this approach entails the development and application of practices tailored to the local situation and assessed by indicators of conservation and biodiversity enhancement as well as traditional measures of agricultural output. Market mechanisms, such as certification schemes developed by professionals, farmers, Government bodies and other stakeholders, provide an important incentive for farmer adoption. The idea is to turn a set of apparent constraints on farmers and the agri-food industry into a win-win, profitable situation.

Box 11

Case study. Developing measures to manage agro-ecosystems

As part of its wider efforts to enhance on-farm biodiversity, Bayer CropScience opened biodiversity centres in the company's research farms in the United Kingdom of Great Britain and Northern Ireland in 2007 in order to evaluate the impact of measures such as the establishment of beetle banks, hedgerows and ponds on farm biodiversity. What is learned is shared with farmers, distributors, agricultural consultants and the wider community to stimulate replication. In Brazil, the company restored farmland surrounding a lake: about 8,000 native tree species were planted, reducing soil erosion, stabilizing water flow and fostering the return of many native wildlife species. A manual developed during the pilot project gives directions on growing native plants. This encouraged scaling-up and has resulted in the planting of more than 100,000 native trees so far.

V. Drought, desertification and climate change

42. The World Bank *World Development Report 2008* notes that part of the falling crop production in sub-Saharan Africa could be attributable to climate change, an important risk factor for food production and development that is likely to have a disproportionate impact on farmers in developing countries. In some cases, it will exacerbate existing problems, such as water scarcity or irregular rainfall. In others, it will create new challenges, and there are many uncertainties, among them, how various crops, pests and diseases will adapt to new climatic conditions.

43. The potential impacts of climate change and the role of technologies to help communities adapt to its effects are particularly important in the context of sustainable agriculture. Agri-businesses are actively developing technologies to provide stress-tolerance to crops so they are better able to withstand extreme conditions. Examples include new varieties with greater drought and salt resistance that maintain yields while decreasing the need for irrigation. Specific genes have already been identified that allow plants to survive with less water. Increasing the ability of plants to withstand the stresses of high temperatures will improve yields in some regions, and increasing salinity tolerance in crops will allow land that has been stressed by climate change to be more productive.

Box 12**Case study. Breeding plants that resist the stresses associated with climate change**

One impact of climate change is the growing frequency of extreme weather events, which substantially increases the vulnerability of global agriculture. Improved crops that can withstand increasingly tough conditions will help to ensure that agricultural productivity will continue to meet the demands placed upon it. Bayer CropScience is currently developing stress-tolerant plants that not only adapt to drought (as would drought-tolerant crops) but can also better cope with floods, heat, cold and salinity. Since stress tolerance pathways exist in all plants, it is expected that this enhancement will be applicable to a majority of crops, if not all.

44. Agricultural business and industry also support universities and public research institutes. Agri-business supports the World Bank recommendations to increase investment in agricultural research and development (public and private) and foster multi-sectoral approaches to capture the synergies of technology, particularly in sub-Saharan Africa.

45. Further development of long-range weather forecasting, insurance against crop failure and other disasters, flood prevention mechanisms and improved soil and water management techniques are examples of adaptation strategies that will benefit rural communities.

Box 13**Case study. Drought insurance programmes reduce farmer risk**

An innovative programme launched in 2005 for groundnut farmers in Malawi helps farmers to obtain certified seeds, which produce increased yields and revenues as well as greater resistance to disease. The National Smallholder Farmers' Association of Malawi, in conjunction with the Insurance Association of Malawi and with technical assistance from the World Bank and Opportunity International Network, financed by the Swiss State Secretariat for Economic Affairs, designed the index-based weather insurance contract. If a drought leads to insufficient groundnut production, the bank pays the loans of insured farmers directly. If there is no drought, the farmers benefit from selling the higher-value production. This is the first time that such index-based weather insurance policies have been sold to smallholder farmers in Africa. A similar pilot in India in 2003 has been expanded to more than 250,000 farmers.

46. In addition to adaptation, progress is also being made to identify and implement mechanisms for rural communities to capitalize on the potential to mitigate and offset emissions by improving management of soil, water and forestry

resources, preventing deforestation, producing bioenergy and carrying out other socio-economic development options in rural areas.

Box 14

Case study. Linking emissions reductions in packaging and on-farm carbon sequestration

The United Kingdom subsidiary of the global packaging-products company Tetra Pak has been working hard to reduce its manufacturing emissions of greenhouse gases (by nearly 25 per cent between 2001 and 2005).

To supplement these efforts within the company and to offset its remaining emissions, it has been buying carbon credits from farmers in the Bushenyi district of Uganda who plant indigenous tree species and from biomass and solar energy projects in India and Sri Lanka. In the tree-planting project, the farmer is entitled to any ancillary benefits — for example, letting goats graze there and using pruned branches — as long as the trees themselves are not harmed. Payments are channelled through carbon broker Bioclimatic Research and Development and a Ugandan national conservation trust.

47. Improved soil management techniques, including conservation tillage, contour ploughing, direct drilling and under-cropping are being deployed to help address soil erosion, particularly in zones that are identified as most vulnerable to the direct impacts of climate change. Conservation tillage, made possible through the use of herbicides, protects land from soil erosion, increases soil organic matter and improves retention of soil moisture, thus protecting valuable water resources.

A. Deriving renewable raw materials from biomass for the production of energy and in the chemical sector has major implications for global agriculture

48. Driven by intensifying climate change discussions, concerns about security of energy supplies and by rising oil prices, the use of biomass for biofuels, energy production and in the chemical sector is growing. Targets set for biofuels in the United States (17 per cent by 2017) or in Europe (10 per cent by 2020) and for renewable energy production (20 per cent in Europe by 2020, mainly based on biomass use) are first political steps. But the use of wood and plant oils as fuels for electricity and heat production is already growing. In the chemical sector a significant part of raw materials in the production of organic chemicals is already bio-based. For example, in Europe, about 10 per cent of the feedstock for organic chemicals production consists of raw materials such as animal and vegetable oils, starch, cellulose, carbohydrates and others. The first large ethylene plants with bioethanol as the feedstock have been announced in Brazil.

49. It is still very unclear how much biomass is available for technical purposes. This is due to several factors, such as progress in agricultural techniques, climate

change, future consumption patterns and water availability as well as interactions with the imperative of supplying food and feed for a population of up to 9 billion people in 2050. Optimistic experts talk about covering 60 to 70 per cent of our future energy consumption; pessimists say 30 per cent. There is currently no surplus of biomass, and competition between its use for food/feed purposes and for technical purposes can already be felt and will intensify in the future. The major part of the biomass available for technical uses in future will come from the tropical countries in South America, Africa and South Asia; however, a large share of the consumption will occur in North America and in Europe.

50. Many social and environmental questions have to be addressed: difficulties of food and feed availability, especially for the developing countries, dramatically rising and increasingly volatile prices for food and feed, ecosystem damage (e.g., cutting down tropical rain forests), impacts on biodiversity, and so on. Certification systems and standards could at least partially address such issues, but the implementation of effective schemes is not a simple affair.

51. An integrated approach to the use of biomass is needed. Isolated targets in different regions for single uses would cause growing problems and intensify the competition problem. An analysis of the global availability of biomass is needed as the basis for an integrated worldwide strategy to optimize the technical use of limited sources of biomass.

Box 15

Case study. Syngenta partnership to develop biofuels

Syngenta and Diversa Corporation have a 10-year partnership to research and develop a range of new enzymes to convert pre-treated cellulosic biomass economically to mixed sugars, one of three key steps in biofuel production. A pilot project in the United Kingdom of Great Britain and Northern Ireland supplies high-yielding oil seed rape seeds to farmers who sell the crops for electricity generation (see www.syngenta.com/en/social_responsibility/agriculture_biofuels.aspx).

VI. Africa: a particular context

52. Accelerating the development of African agriculture is critical to the sustained growth of its economies and improving the lives of millions of poor people, particularly women, who depend directly upon agriculture for their livelihoods and food security. In sub-Saharan Africa, agriculture contributes at least 40 per cent of exports, 30 per cent of gross domestic product, up to 30 per cent of foreign exchange earnings and 70-80 per cent of employment. Business Action for Africa⁴ members and other businesses that operate in Africa in the agri-food sector recognize the crucial role of agriculture and the need to address the following key issues.

⁴ www.businessactionforafrica.org.

53. Effective risk management lies at the heart of achieving agriculture that is environmentally, socially and economically sustainable. There are many inherent risks in agriculture — such as unpredictable rainfall, depleted soils, pests, weeds, crop diseases and world commodity prices — and farmers in Africa face additional risks, including HIV/AIDS, malaria, political instability and unreliable infrastructure. Climate change will most likely increase these risks. Farmers need information, better access to markets and capital, secure income streams through long-term relationships with customers, appropriate technologies, farm inputs, diversified crop and animal portfolios, secure land tenure and adequate supplies of water and irrigation.

54. Connecting smallholder farmers with local markets and supply chains that link with national, regional and global economies is crucial for scaling up growth in the agricultural sector and improving the prospects and welfare of farmers. Building the capacity of farmers to meet the requirements of customers is vital so they can be successfully integrated into commercial supply chains. This means being able to meet product quality and environmental standards, and to get products to customers on time and in good condition, and may require significant investment in training, inputs, irrigation and infrastructure.

Box 16

Case study. Using supply chain partnerships to support agriculture in Africa

Unilever has been an active proponent of schemes to broaden the supply-base and support local livelihoods, particularly in its tea and palm-oil estates. Lipton/Unilever Tea has a partnership with Rainforest Alliance on sustainability certification. Other initiatives are being piloted to check the viability of the business-model: for example, growing herbs and spices in the Sauri Millennium Development village in Kenya which links into a wider engagement through Business Alliance Against Chronic Hunger.

A Unilever partnership with Tanzania Forest Conservation Group, Ministry of Natural Resources, World Agroforestry Centre and the World Conservation Union promotes *Allanblackia* seed production for fat/oil, as a substitute for palm oil in spreads, soap and as an alternative source of farmer income. Farmers, transporters and crushers benefit, and the value of *Allanblackia* trees encourages farmers to reverse deforestation (see www.unilever.com/ourvalues/environment-society/case-studies/agriculture/?linkid=navigation).

55. Effective farmer organizations are important support groups that can play a role in joint assurance, certification, training and purchasing agreements. These are particularly effective where linked to support programmes such as farmer field schools.

56. Local small and medium enterprises have an essential role to play in creating markets, supplying inputs, processing produce and providing employment for rural communities. Investment in research and rural institutions is needed to increase

opportunities and choice and to improve information on accessing markets, for example through mobile telephones.

57. Developing long-term, stable relationships with customers is vital to improve the security of farmers' incomes. Sustainable agriculture will not be achieved unless farmers have a realistic idea of the current and future levels of demand for their crops, the right incentives to invest in their farms over the long term and a diversified crop portfolio. Too often, farmers are encouraged to grow a different crop, expecting higher levels of demand and better prices than their existing crops, only to find that too many other farmers have been encouraged to do the same or that cheaper imports have been allowed, leading to oversupply and much lower-than-expected prices.

Box 17

Case study. Securing supply chains, raising production standards and improving livelihoods

In 2002, Nestlé co-founded the Sustainable Agriculture Initiative Platform (www.saiplatform.org), which aims to foster sustainable agriculture practices worldwide. Nestlé sponsors a number of programmes in Africa, including working with smallholder farmers in Ethiopia to grow high-quality fair-trade coffee, diversify their crops, improve their communities and achieve a higher standard of living. With more than two thirds of the world's cocoa supplies sourced from West Africa, Nestlé has played a leading role in the region to help put in place a series of global partnerships to improve both labour standards in cocoa farming and living standards for farmers and their families. These include the sustainable tree crops programme, which improves cocoa production techniques and yields, and the international cocoa initiative, which is working to promote best practices and help sensitize communities towards child labour issues (see www.nestle.com/SharedValueCSR).

58. Rather than promoting overdependence on particular crops, which is unsustainable if prices collapse, efforts to improve the welfare and productivity of farmers should focus on the farmers themselves, improving their capacity, knowledge, practices and livelihoods, and helping them grow a diversified portfolio of crops.

Box 18**Case study. The Business Alliance Against Chronic Hunger**

The Business Alliance Against Chronic Hunger was formed in 2006 by a group of chief executive officers and public leaders to reduce hunger in Africa by strengthening value chains through business development and market linkages. Globally, the Alliance promotes effective business models to reduce hunger, facilitates dialogue and engages in global partnerships with Governments, non-governmental organizations, international agencies and communities. In Siaya, the poorest district in Kenya, where 38 per cent of children are stunted by malnutrition, over 30 companies — including Sealed Air, General Mills, TNT and Technoserve — plus key partners — including non-governmental organizations such as the Millennium Development Goals Centre, international agencies and the Government of Kenya — are taking action in staple crop production and market linkages; integrated processing and packaging; retail and consumer market development; and entrepreneurial capacity-building (see www.weforum.org/en/initiatives/hunger/index.htm).

59. Land tenure is central to the sustainability challenge. Farmers have little or no incentive to invest in land stewardship if they do not have secure tenure. Land tenure across Africa takes many forms, but secure formal property rights are largely non-existent: in sub-Saharan Africa only 1 per cent of land is officially registered. The absence of formal titles to land means that farmers have no collateral against which to borrow. Faced with prohibitively high interest rates, they lack the capital needed up front to invest in their land or to grow new, more profitable crops.

60. Sustainable agriculture is not possible without adequate water supplies and irrigation. Barely 4 per cent of arable land in sub-Saharan Africa is irrigated (compared with some 39 per cent in India), exposing farmers to great risks from low rainfall. Farmers with insecure land tenure, limited access to capital and unreliable income streams have little incentive or capability to invest in better soil and water management practices and irrigation systems.

61. The most profitable crops typically require the most water inputs. Appropriate micro-irrigation systems such as micro-dams, catch and store technologies and drip feed irrigation schemes can be effectively managed by rural communities and do not cause the considerable environmental and social disruptions associated with large-scale irrigation projects. According to the International Water Management Institute, the gains to be made from such initiatives are large, but require a radically different approach to managing total rainfall.

A. Government commitment and support are fundamental

62. Many African Governments have made agriculture a national priority. The African Union Comprehensive Africa Agriculture Development Programme is finalizing its strategic framework.

63. Agri-business supports the conclusions of the African Union's Africa Fertilizer Summit held in June 2006, in Abuja, Nigeria. The Summit addressed Africa's food challenges, soil fertility crisis and the need for regional and national strategies, development plans and financing mechanisms in the agricultural sector, including questions of infrastructure, access to complementary inputs, and agro-dealer networks. In the Abuja Declaration on Fertilizer for the African Green Revolution, Heads of State and ministers resolved to increase the use of fertilizer from the current average of 8 kilogram per hectare to an average of at least 50 kilogram per hectare by 2015. Shorter-term goals for African Union member States included measures to reduce the cost of fertilizer procurement, especially through harmonization of policies and regulations to ensure duty- and tax-free movement across regions; to improve farmers' access to fertilizers; to address the particular needs of women farmers and to develop and strengthen the capacity of youth, farmers' associations, civil society organizations and the private sector to address fertilizer needs.⁵

64. The Conference of African Ministers of Finance, Planning and Economic Development in April 2007, in Addis Ababa, urged Governments to scale up public sector investments in infrastructure, agriculture, health and education, as the foundation for private sector-led growth to meet the Millennium Development Goals. The ministers resolved to launch the African Green Revolution by the end of 2008 by:

- (a) Ensuring the access of smallholder farmers to fertilizer, improved seeds and targeted subsidies;
- (b) Investing in water management;
- (c) Strengthening agricultural extension services;
- (d) Expanding rural infrastructure, especially roads and energy services;
- (e) Promoting regional cooperation in intra-African trade and investment in agriculture.

65. Agriculture is crucial to the sustained growth of Africa's economies and to improving the lives of millions of poor people, especially since population growth still outstrips food production on that continent. Agriculture is an extremely heterogeneous sector, encompassing subsistence and smallholder farmers as well as cooperatives and large-scale plantations and other forms of production. In this regard, policies need to be flexible enough to enable the diverse business of agriculture to flourish at every level of the supply chain.

66. The challenges posed to agriculture by the changing geography and demographics in many African countries must not be underestimated, but they also provide opportunities, such as the new urban markets for agricultural products arising from rapid urbanization. Linking farmers to these markets through efficient value chains and enhanced competitiveness is important. The return of agriculture to the international development agenda is an important window of opportunity not to be missed.

⁵ www.africafertilizersummit.org.

**Economic and Social Council**Distr.: General
10 January 2008

Original: English

Commission on Sustainable Development**Sixteenth session**

5-16 May 2008

Item 3 of the provisional agenda*

Thematic cluster for the implementation cycle**2008-2009 — review session****Discussion papers submitted by major groups****Note by the Secretariat****Addendum****Contribution by the scientific and technological community******Contents**

	<i>Paragraphs</i>	<i>Page</i>
I. Introduction	1-4	2
II. Agriculture, land and rural development	5-50	2
III. Drought and desertification	51-70	11
IV. Major international scientific endeavours	71-87	15
V. Education, training and institutional capacity-building in science and technology	88-93	18
VI. Conclusion	94-96	20

* E/CN.17/2008/1.

** The views and opinions expressed do not necessarily represent those of the United Nations.



I. Introduction

1. This paper, prepared by the scientific and technological community, provides an overview of the key science and technology issues related to the themes of the sixteenth and seventeenth sessions of the Commission on Sustainable Development: agriculture, rural development, improved management of land resources and combating drought and desertification. Throughout the paper special attention is paid to Africa, the regional focus for the current biennial cycle of the Commission.

2. Agenda 21 and the Johannesburg Plan of Implementation call for numerous science- and technology-based actions relating to the themes under review. This paper presents a discussion of the progress that has been made and the obstacles that still exist in implementing such actions. It also outlines major new challenges and opportunities in harnessing science and technology for a more sustainable path to development in the five themes under review. The first target is to meet the Millennium Development Goals by 2015.

3. As with all major sustainable development challenges, the issues of agriculture, land, rural development, drought and desertification must be addressed in a way that integrates the three pillars — social development, environmental protection and economic development. In order to help decision-makers define and implement these integrated approaches, the scientific and technological community must continue striving to become more policy-relevant, participatory and capable of responding to issues ranging across the geographical scale, from local to global. There is also a strong need for more integrative, interdisciplinary approaches, which will require continued efforts to overcome persistent barriers that exist among the natural, social, engineering and health science domains.

4. In preparing this paper, the International Council for Science and the World Federation of Engineering Organizations, co-organizers of the scientific and technological community major group, consulted their members worldwide, who have expertise across the relevant scientific and technological disciplines. The International Social Science Council also provided valuable input. This paper has particularly benefited from: the International Assessment of Agricultural Science and Technology for Development; the findings of the Millennium Ecosystem Assessment; and the work of the Global Environmental Change and Food Systems project. Information on these and other relevant scientific initiatives is provided under "Major relevant international scientific endeavours".

II. Agriculture, land and rural development

A. Progress in agricultural sciences and their contribution to reducing hunger and poverty

5. Agriculture plays an important economic and social role and currently engages some 2.6 billion people around the world. The majority of the world's poor and hungry live in rural settings and are directly or indirectly dependent on agriculture for their livelihoods. The proportion of the population dependent on agriculture ranges from 3 per cent in Europe and North America, to more than 60 per cent in South-Eastern and Southern Asia, the Pacific, and sub-Saharan Africa.

6. Agricultural knowledge, science and technology have contributed to some major developmental achievements, including reducing hunger in many parts of the world and ensuring food security at a scale not seen before in history. The science that made the Green Revolution of the 1960s and 1970s possible has increased the income of many small farmers, particularly in Asia, and preserved millions of hectares of forest and grasslands — conserving biodiversity and reducing the amount of carbon released into the atmosphere.

7. Advances in agricultural knowledge, science and technology have enabled substantial gains in agricultural production in industrialized and developing countries alike. Over the past 30 years, food production has tripled in developing countries, outstripping population growth. Over the same period, the proportion of undernourished people in developing countries has dropped from 35 to 17 per cent and poverty has decreased. However, the poorest and most marginalized rural and urban people continue to miss out on the benefits provided by advances in agricultural knowledge, science and technology.

B. Challenges in feeding a growing world population and in meeting increasing demands for dietary improvements

8. These successes notwithstanding, future challenges are daunting. World population is expected to reach nine billion by 2050 and the demand for food is expected to more than double in a similar time frame, with the per capita meat consumption in developing countries also projected to increase significantly. Science-based solutions for sustaining increases in productivity while protecting ecosystems are the key to addressing these challenges.

9. In many circumstances, the benefits of increasing agricultural production are outweighed by the drawbacks in the efforts to achieve them, including: degradation of the natural resource base; declining human health (associated with agricultural practices); and social exclusion. Some 30 per cent of irrigated lands are already degraded and water use is expected to increase by 50 per cent over the next 30 years. There is concern that the agricultural growth required to meet society's increasing demand for food will further degrade the environment and that this will, in turn, further undermine food systems and destabilise long-term food security. These concerns are particularly pertinent to Africa, where food security is already a major issue.

10. The findings of the Millennium Ecosystem Assessment were a wake-up call concerning the degradation of many agroecosystems worldwide, increased risks of non-linear changes and the exacerbation of poverty for many people.

11. Preliminary findings of the International Assessment of Agricultural Science and Technology for Development point in the same direction: agriculture policies can no longer externalize the costs of food and agricultural production without great economic, environmental, social and health risks. Future increases in food and other agricultural production will have to come from sustainably intensified agriculture and more efficient use of the natural resource base, particularly water. Successfully meeting sustainability and productivity requirements places increased importance on the multiple functions of agriculture:

- (a) Producing food and fibre;

(b) Providing ecosystem services, and conserving natural resources and biodiversity;

(c) Providing livelihoods (income, health and nutrition) and supporting the quality of rural life.

12. Climate change will soon have a major impact on food systems. The challenge is to reduce the vulnerability of the agricultural sector to climate variability and the projected changes in extreme weather events, that is, floods, droughts and heat waves and also to reduce climate- and weather-related risks to regional and global food supplies. Climate change and changes in other aspects of the biogeophysical environment will add to the difficulties of existing food-insecure populations, particularly in parts of Africa, and may generate more widespread food insecurity in many parts of the developing world.

13. Another challenge for agricultural knowledge, science and technology is to address the needs of small-scale farms in diverse ecosystems and to create realistic opportunities for their development where the potential for improved productivity in the area is low. Smallholder economies in developing countries continue to be the poorest communities in the world today. The situation of the majority of rural and farm women in developing regions has not fundamentally improved in recent decades and is often worse compared to men with regard to work conditions, health and access to and control over natural resources, employment and income.

14. According to the International Assessment, the main challenges for agricultural knowledge, science and technology posed by multifunctional agricultural systems in developing regions are:

(a) How to increase food, fibre and fuel productivity and diversity while maintaining environmental and cultural services;

(b) How to improve welfare and rural livelihoods and enhance economic benefits of agriculture;

(c) How to empower marginalised stakeholders to sustain the diversity and productivity of their agriculture and food systems;

(d) How to increase sustainable production in marginalised, rainfed areas and link rural populations in these areas to local, national and global markets;

(e) How to increase profitability and environmental integrity in a sustainable manner for small-scale farmers in less well-endowed areas.

C. Interactions between climate change and agriculture, particularly in developing countries

15. Climate change influences and is influenced by agricultural systems. The two challenges are:

(a) To adapt to climate change while reducing the vulnerability of the agricultural sector — including the risks to regional and global food supplies — to climate variability and the projected changes in climate and associated extreme weather events, that is, floods, droughts and heat waves;

(b) To reduce the impact on the climate system by reducing the emissions of greenhouse gases from the agricultural sector and associated agrofood systems.

16. Both challenges need to be addressed through the generation and use of agricultural knowledge, science and technology — that is, through changes in agricultural practices, technologies and policies. Understanding the trade-offs between achieving food security and environmental goals involved will be critical.

17. Climate change is already being felt in terms of gradual increases in temperature; increased variability in annual rainfall; greater prevalence of extreme events, such as drought and floods; and changes in land and biodiversity resources. Rural communities must adapt to these changes if any development progress is to continue and if further impoverishment is to be avoided.

18. In general, the poor are the most vulnerable to climate change. However, the vulnerability of people and their agricultural systems is very complex, due to interacting climate-related stresses. The year-to-year variability in climate already contributes to rural poverty in places where exposure is high and adaptive capacity is low. Thus, agricultural adaptation and mitigation pathways need to be developed that are pro-poor.

19. While a few areas stand to be positively affected by climate change, which will offer some opportunities, the impact of climate change on agriculture is predicted to be detrimental and expected to threaten food security in many parts of the world, particularly in Africa. In some regions, climate change has the potential to forestall or reverse the gains made during and since the Green Revolution, for example, by reducing the water available to irrigation-dependent systems. New solutions will be required to increase resilience in high-potential regions, and to reduce vulnerability in areas where the Green Revolution has not had a significant impact, for example, in sub-Saharan Africa.

20. In many areas, there is a huge knowledge gap on how best to adapt agricultural systems to climate change. There is a need to better understand how climate change will affect cropping systems, agroecosystems and the livelihoods of farmers and to better understand the impact of these changes on the global agricultural and food sector. There is also a need to strengthen policymaking and policy implementation to support the mainstreaming of agricultural knowledge, science and technology, targeting adaptation and mitigation of climate change in the agricultural sector of developing countries.

D. Science and technology for small-scale farmers in developing countries

21. Disparities between small-scale farming and industrial agricultural systems have increased over the past 50 years. A key factor is labour productivity, which has increased enormously in industrialized agriculture and stagnated in most smallholder systems in developing countries. The smallholder systems have not been able to compete with modern production systems, resulting in the impoverishment of rural populations and countries. Countries and communities based mainly on smallholder economies are the poorest in the world today and the most threatened by ecosystem degradation. The average farm size in industrial countries has increased from around 10 hectares to more than 100 hectares, while in

developing countries, farms have decreased in size from around two hectares to less than one — making investment, innovation or change very difficult.

22. Scientific advances and new technologies do not necessarily reach the smallholders who could benefit most because extension services and basic agricultural research are underfunded in the countries that need them most, particularly in sub-Saharan Africa. Uptake of new scientific developments — whether biotechnology or land use and drought management — depends on extension to rural areas, and despite excellent work carried out by agricultural research centres, the poorest and most marginalized communities are often not reached. Universities, technical schools and extension services are often so underfunded as to be non-functional. In some cases, extension services through non-governmental organizations have been more successful, provided they are working with the scientific, engineering and technological communities.

23. Extreme poverty and hunger push people onto marginal lands and fragile ecosystems characterized by low soil fertility, drought stress and increasing land degradation. The current global system of supporting agriculture pits small-scale, largely subsistence farmers in rainfed agriculture systems against farmers who up to now have been provided with much support from their own Governments to increasingly capture economies of scale — through specializing their farms and by externalizing social and environmental costs. Research to develop new technologies and production methods, which are relevant to the poor, is seriously underfunded.

24. Ensuring the development, use and adaptation of agricultural knowledge, science and technology by small-scale farmers requires acknowledging the inherently diverse conditions in which people live and work, as well as gender issues. Hence, technology development would benefit from knowledge about farmer-specific environments and the gains that can be achieved from participatory methodologies that empower small-scale producers. The development of more sustainable low-input practices to improve soil, nutrient and water management will be particularly critical for communities currently without access to markets. Resource-poor farmers must be given help so they can use their local knowledge to develop innovative methods of managing soil fertility, genetic diversity of crops and natural resource conservation, and they must be empowered through appropriate policies and institutional arrangements to gain access to markets.

E. Making agriculture more environmentally sustainable

25. Sustainability issues in agricultural development are numerous, and include:

- (a) Conservation of renewable natural resources;
- (b) Providing ecosystem services;
- (c) Conserving biodiversity;
- (d) Management of the nitrogen cycle;
- (e) Reduction in greenhouse gas emissions;
- (f) Addressing adaptation and vulnerability to climate change.

26. Advanced knowledge in agroecology offers the potential to increase productivity while providing critical ecosystem services, including improved soil

and water quality and carbon sequestration. There is a need for integrated land and water management. Often land resources are poorly managed due to lack of access to information and lack of alternatives, or they are poorly managed deliberately in order to exploit short-term benefits of resource use. Increasing rates of soil degradation in many regions may further limit the ability of agriculture systems to reduce food insecurity.

27. Water availability for agriculture is one of the most critical factors for food security and sustainable agriculture. The expansion of irrigation will continue to depend on availability of water resources sufficient both to produce food for the growing world population and to meet increased municipal, industrial and environmental requirements.

28. Soil fertility is another critical factor for the production of food, fibre and fuel crops. For nitrogen-poor regions, including Africa, the overall challenge is to increase the nutrient status of soils. Currently, small-scale farmers in developing countries most often lack the money needed to buy industrial fertilizers. Governments and the development and industrial fertilizer communities are increasingly aware of the need for a concerted, integrated effort, including biological nitrogen fixation, to address this challenge. From a biogeochemical perspective, this effort should include studies on the fate of the added nitrogen to ensure that losses from the agroecosystem to groundwater, for example, are minimized.

29. For regions with nitrogen-rich soils, actions should focus on decreasing the amount of nitrogen fertilizer required for agricultural production through, in particular: increasing the nitrogen use efficiency of crop grains; increasing the nitrogen retention efficiency of animals; and decreasing the amount of food wasted.

30. Environmental technologies, such as integrated pest management, agroforestry, low-input agriculture, conservation tillage and pest-resistant genetically modified crops, often face policy gridlock with formal agricultural knowledge, science and technology, the Government, private industry, the public and media taking highly polarized positions.

F. Agriculture and the growing demand for biofuels

31. Bioenergy is being developed in many countries to increase energy security, reduce greenhouse gas emissions and stimulate rural development. However, economic, social and environmental issues limit the extent to which these goals can be met with current biofuel technologies. There is great concern expressed in many developing countries about the future of biofuels and their effect on food prices and food policies. Nevertheless, numerous countries already have promising programmes for producing bioethanol and biodiesel from a variety of crops — cassava, castor beans, cotton seeds, jatropha, palm oil, soybean, sunflower and sweet potato.

32. First generation biofuels such as bioethanol and biodiesel are economically competitive with fossil fuels only in the most efficient feedstock production markets and under favourable market conditions of high oil and low feedstock prices. In most countries they depend on direct and indirect subsidies. While non-market benefits such as energy security and reduced greenhouse gas emissions may justify

these subsidies, the net benefits remain uncertain. The intensity of land and water use in the production of first generation biofuels can lead to serious threats to the environment and reduce food security in developing countries.

33. Millions of people in developing countries, particularly in sub-Saharan Africa, South Asia and parts of Latin America, depend on traditional bioenergy, such as wood fuels, for their basic cooking and heating needs. This can hold back development by posing considerable environmental, economic and social challenges. Efforts are needed to improve traditional bioenergy and to accelerate the transition to modern forms of energy.

34. In some areas, bioenergy options such as biogas and power generators operating with locally available biomass — including vegetable oils, manure and agricultural and forestry by-products — can become the most economical and reliable providers of energy for the poor. Liquid biofuels may become an interesting option for rural areas where biomass is available locally. In remote rural areas and on islands, where fossil fuel prices are usually high due to transport costs, bioenergy systems may prove to be the most economic option. In countries where large numbers of farmers subsist on very low incomes, local processing of bioenergy through community cooperatives could provide extra income and social inclusion for poor families.

35. A shift towards cellulose-based second-generation biofuels using wood and grassy crops would offer greater reductions in carbon dioxide emissions and less land used per unit of energy. However, technical breakthroughs would be required to achieve this. The potential of second-generation biofuels to be economically, environmentally and socially sustainable needs to be further explored.

G. The opportunities of biotechnology

36. Gene technology has many applications that can be used to improve the management and efficiency of agricultural practices. Although experimental transgenic strains have been developed for various species of crops, trees, livestock and fish, only transgenic crops are used commercially in agriculture today.

37. The first wave of commercially available genetically modified crops addresses production traits, and includes soybean, corn, cotton and oilseed rape with insect resistance and/or herbicide tolerance. The second wave, which is being developed, addresses quality and nutritional traits; and the third wave addresses complex stress response traits and the production of specific compounds.

38. Biotechnology developments could significantly increase agricultural productivity, addressing the need for greater food production in the coming decades and potentially providing important benefits also for small-scale farmers in the developing world. However, there is widespread public debate about genetically modified crops and the risks to human health and the environment, the efficacy of the new products and the socio-economic and ethical issues surrounding their development and use.

39. In 2003, International Council for Science commissioned and published a meta-analysis of existing authoritative reports from national science academies and other expert bodies on the risks and societal dilemmas of genetically modified organisms. The analysis found no known instances of harmful effects on human

health resulting from the consumption of genetically modified food crops. When genetically modified crops are developed with novel characteristics, they need to be assessed for health risks on a case-by-case basis. As with foods which are not genetically modified, consumers must be informed by appropriate labelling if the food contains known or suspected allergens.

40. Current agricultural practices have both positive and negative impacts on the environment. The same can be said about current and future genetically modified crops, with specific impacts depending on the genetic application, the agricultural system and the environment (agroecosystem) in which it is used. Consequently, environmental impacts need to be assessed on a case-by-case basis, taking into account specific risk factors. There is broad agreement that each country needs regulatory systems that are science-based, transparent and involve community participation. Known risks of environmental impacts such as gene transfer to non-genetically modified crops or a genetically modified crop establishing itself as a weed or invasive species can be managed through appropriate regulations and monitoring.

41. Other concerns relating to the use of genetically modified crops by small-scale farm holdings in developing countries must be addressed. The benefits must be shared equitably by holders of genetic resources, owners of indigenous knowledge and inventors. In poor societies, the current perception is that small-scale farmers receive more of the socio-economic costs than the benefits, as crop yields are not necessarily higher. The issue of poor farmers in developing countries becoming dependent upon a small number of global seed companies should be considered in a holistic sense, ensuring sustained socio-economic benefits to the farmers while capturing the great opportunities provided by advances in biotechnology.

H. The need for a fundamental shift in agricultural research and development strategies

42. A fundamental shift in science and technology strategies, related policies, institutions, capacity development and investments is required. Such a shift will recognize and give increased importance to the multifunctionality of agriculture and will take account of the complexity of agricultural systems within diverse social and ecological contexts. The shift will depend on new institutional and organizational arrangements to promote an integrated approach to the development and deployment of agricultural knowledge, science and technology. Success will require increased public investment in agricultural knowledge, science and technology; development of supporting policies; revaluing traditional and local knowledge; and an interdisciplinary, holistic and system-based approach to knowledge production and sharing. These policies and institutional changes should be directed primarily at those who have been served least by previous agricultural knowledge, science and technology approaches: resource-poor farmers.

43. Agricultural research needs to develop new models and approaches at the system level, rather than at crop or plot level. This is particularly true for Africa. One of the reasons for the relative failure of Green Revolution approaches is the heterogeneity of the physical, social, cultural and economic environments in Africa. Calls for approaches other than the Green Revolution have been made over the past decades. However, it is difficult to create innovative scientific and engineering

approaches in the absence of a supportive institutional framework. Institutional arrangements in Africa have, so far, emphasized traditional approaches to research in agriculture and rural development. An institutional framework which is facilitating broader interdisciplinary work and more creative research is required.

44. A systems approach will focus on a better understanding of the interactions and feedback mechanisms of biophysical and socio-economic processes, which determine food system viability, and management practices, which enhance the resilience of these systems to future shocks and stress. To address the complex interactions, trans-disciplinary collaboration between the natural and social sciences is required. There is an urgent need for increased collaboration between the agricultural research and global environmental change communities to address climate change adaptation and mitigation.

45. Most national agricultural research institutions and subregional organizations in Africa, South and South-East Asia and Latin America emphasize that increasing agricultural productivity is the way forward. While this emphasis is essential in countries where food security is uncertain, the increase of agricultural productivity needs to occur in the context of sustainable management of natural resources and equitable economic development. This needs to be reflected in improved scientific approaches and innovative engineering. If productivity is emphasized and sustainable resource management and equitable distribution of the benefits are ignored, serious conflicts can be expected and the vulnerability of agriculture in many developing countries, particularly in Africa, could increase to threshold levels of irreversibility.

46. On their own, advances in science and technology will not lead to relevant effective and efficient broad-scale applications unless investment in society in rural areas in health, education, extension services and women's needs is increased. The challenges ahead demand a greater focus on management systems: from crop to whole farm to agroecosystems. Management systems require a sophisticated understanding of the institutional dimensions of management practices and of decision processes that must be coordinated across variable spatial, temporal and hierarchical scales. The increasing focus on intellectual property rights in agricultural research and development, particularly given that many resource-poor farmers save seeds from season to season and also breed for local conditions, requires serious considerations. Agricultural knowledge, science and technology specialists will need a profound understanding of the legal, trade and policy frameworks that will increasingly steer agricultural and food system development. Agricultural knowledge, science and technology organizations should interact more with academic institutions in biological, ecological, earth, social and engineering sciences to address the challenges of sustainability, poverty, market-oriented innovation, and demand-led technology generation, access and use.

I. Investments in agricultural science and technology: a rich and poor countries divide

47. Globally, public sector research and development is becoming increasingly concentrated in a handful of countries. In 2000, the United States and Japan accounted for 54 per cent of public spending, while three developing countries — China, India and Brazil — accounted for 47 per cent of the developing world's

expenditure on public agricultural research. Meanwhile, 80 countries, with a total population of more than 600 million in 2000, spent a combined total of six per cent of the worldwide investment in agricultural research and development.

48. Declining investments in formal agricultural knowledge, science and technology by international donors and a number of national Governments is causing concern among developed and developing countries. Data analysed by the International Assessment indicates that public investments in agricultural research and development continue to grow. However, rates declined during the 1990s and investments stalled or declined in many industrialized countries. Investments by countries from South and South-East Asia and the Pacific grew relative to other regions, with an annual growth rate of 4 per cent in the 1990s. As a result, this region now accounts for a greater share of global public research and development investment — from 20 per cent in 1981 to 33 per cent in 2000.

49. The annual growth rate of total spending in sub-Saharan Africa decreased from 1.3 per cent in the 1980s to 0.8 per cent in the 1990s. In 24 countries in sub-Saharan Africa for which time series data are available the public sector spent less on agricultural research and development in 2000 than a decade earlier. This is an alarming trend.

50. In the industrialized countries, investment by the private sector has increased and is now higher than total public sector investments. In contrast, private sector investment in developing countries is small and will likely remain so, given weak funding incentives for private research. In 2000, private companies accounted for 8 per cent of total spending on agricultural research and development in the developing world. Private investment in agricultural knowledge, science and technology is, and is likely to remain, largely confined to commercial technologies, with intellectual property protection, which can earn significant revenues in the market.

III. Drought and desertification

51. Desertification is defined by the United Nations Convention to Combat Desertification as land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities. Land degradation is in turn defined as the reduction or loss of the biological or economic productivity of drylands. In drylands, water scarcity limits the production of crops, forage, wood and other ecosystem provisioning services. Drylands occupy 41 per cent of the Earth's land area and are home to more than 2 billion people.

52. Desertification occurs on all continents and affects the livelihood of many millions of people, including a large proportion of the poor living in drylands. According to the Millennium Ecosystem Assessment Desertification Synthesis report, some 10-20 per cent of drylands are already degraded. If unchecked, spreading desertification will threaten future improvements in human well-being and possibly reverse gains in some regions. Therefore, desertification ranks among the greatest environmental challenges and is a major impediment to meeting basic human needs in drylands.

53. On average, dryland populations, at least 90 per cent of whom live in developing countries, lag well behind the rest of the world in human well-being and

development indicators and suffer from the poorest economic conditions. For example, in Asia, drylands have the lowest Gross National Product per capita and the highest infant mortality among all bioclimatic systems. The relatively low rate of water provisioning in drylands in developing regions limits access to clean drinking water and adequate sanitation, leading to poor health.

54. Poverty-ecosystem links are typically ignored in poverty reduction policies of dryland countries. Even when these links are included, only the economic values are considered. Successful responses should include broader definitions of poverty, which include access to water and energy, health and education, and should try to mainstream the role of ecosystem services in poverty reduction programmes.

55. Inter-annual variability in rainfall and drought events are the natural phenomena associated with desertification. The magnitude and impacts of desertification vary greatly from place to place and change over time. Desertification can be caused by human population pressures and unsustainable land use, or by climate-related processes.

56. Rangelands are resilient to seasonal changes under traditional mobile grazing practices, commonly called transhumance. However, with increasing population pressure, nomads have reduced herd mobility, leading to overgrazing and degradation of rangelands. Moreover, the transformation of rangelands to cultivated systems in order to increase food production and economic benefits has significantly accelerated during the Green Revolution of the past five decades. Transformation of traditional rangelands and sylvo-pastoral dryland systems to croplands increases the risk of desertification due to increased pressure on the remaining rangelands and/or the use of unsustainable cultivation practices. Removal of the natural vegetation cover when combined with unsustainable soil and water management practices in the converted rangelands brings about soil erosion, soil structure change and soil fertility decline.

57. One of the potential new risks for drylands is growing biofuel crops using unsustainable cultivation practices, leading to accelerated soil erosion and desertification. On the other hand, growing biofuel crops using sustainable cultivation practices on semi-arid and sub-humid lands that are unsuitable for food production would not compete directly with food production and could help rehabilitate such soils.

58. Effective prevention of desertification requires both local management and macro policy approaches that promote sustainability of ecosystem services. Focusing on prevention is preferable because rehabilitating desertified areas is costly and delivers limited results. Protection of vegetative cover and integrated land and water management are key methods for preventing desertification. Improved water management practices include use of traditional water-harvesting techniques, water storage, and diverse soil and water conservation measures. Improving groundwater recharge through soil-water conservation, upstream revegetation and floodwater spreading can provide reserves of water during periods of drought.

59. Effective restoration and rehabilitation of desertified drylands require a combination of policies, technologies and the close involvement of local communities. Measures to restore and rehabilitate include restocking organic matter

in the soil and programmes that promote higher plant establishment and growth, including reforestation, seed banks and reintroduction of selected species.

60. The impacts of climate change in drylands will vary from region to region, depending on changes in rainfall and drought patterns. An increase in temperature will also increase evapotranspiration. For the vast drylands of sub-Saharan Africa and Central Asia, it is predicted that the frequency and duration of droughts will increase and further reduce water availability and vegetation productivity.

61. Consequently, the Millennium Ecosystem Assessment Desertification Synthesis report states that climate change is a much greater threat in drylands than in non-dryland systems. In particular, the projected increased scarcity of freshwater as a result of climate change will cause greater stresses in drylands and, if left unmitigated, will exacerbate desertification. The greatest vulnerability is ascribed to sub-Saharan and Central Asian drylands.

62. Desertification also contributes to greenhouse gas emissions. Dryland soils contain more than a quarter of all of the organic carbon stores in the world and nearly all of the inorganic carbon. Unimpeded desertification may release a large portion of this carbon into the atmosphere, with significant feedback consequences to the global climate system. Since carbon dioxide is also a major factor in plant productivity, water-use efficiency may improve in some dryland species that can respond favourably to its increase. This demonstrates that the effect of global climate change on desertification is complex and not yet sufficiently understood.

63. As regards engineering and technology suitable to drylands conditions, applying a combination of locally available sound traditional technology with the selective transfer of locally acceptable technology is a major way to prevent desertification. Conversely, there are numerous examples of practices, such as inappropriate irrigation techniques and technologies, that accelerate, if not initiate, desertification processes. Thus, technology transfer requires in-depth evaluation of impacts and active participation of recipient communities.

64. While our scientific knowledge on dryland environments and socio-economic dimensions has increased during the past 50 years, there are still major gaps in our knowledge, in particular in regard to using holistic approaches and action plans to combat desertification and foster sustainable development of drylands. Dryland research must also address new challenges and opportunities that have emerged.

65. The 2006 United Nations Educational, Scientific and Cultural Organization Declaration on research priorities to promote sustainable development in drylands, commonly called the Tunis Declaration, identified the following research priorities:

- (a) Integrated management of water resources in the context of a looming water crisis;
- (b) Assessing and forecasting dryland ecosystem dynamics in order to formulate adaptation strategies in the context of global change and to alleviate poverty in order to achieve the Millennium Development Goals;
- (c) Agriculture and pastoralism as opportunities for sustainable land use;
- (d) Coping with and managing natural and man-made disasters;
- (e) Formulating and implementing scenarios and policy options for good governance in drylands in the context of global change;

- (f) Identifying viable dryland livelihoods and policy options for the benefit of dryland dwellers, for example ecotourism;
- (g) Education and knowledge sharing for sustainable development;
- (h) Reversing environmental degradation and promoting rehabilitation;
- (i) Costs related to inaction in the field of land degradation;
- (j) Renewable energies suitable for dryland development;
- (k) Evaluating dryland ecosystem services and their trade-offs;
- (l) Interdependence and conservation of cultural and biological diversity.

66. Most of the improved natural resource management strategies for drylands require effective user rights and a high degree of collective action. For example, agroforestry and perennial tree crops are long-term investments and individual farmers will only plant trees if they have secure land or tree property rights to secure future returns from their investment. Customary property rights also remain important. There is a need for effective local institutions, to ensure that common property resources are managed and regulated. Indigenous institutions that perform these roles successfully are often undercut by population growth, encroachment from outsiders and State interventions.

67. There are considerable scientific challenges in detecting thresholds beyond which the changes to dryland systems would be irreversible. This stems partly from our lack of understanding about the interactions between biophysical, social and economic factors, and requires more interdisciplinary research involving natural scientists, social scientists and economists.

68. Another weak point, which is hampering policies and programmes to combat desertification, is the insufficient capacity for long-term monitoring of drylands and desertification. While drylands lend themselves to remote sensing because they are mostly cloud-free, valid interpretation for desertification requires careful calibration and validation against ground measurements — such as evapotranspiration, soil fertility and compaction, and erosion rates. Continuity of ground and satellite-based observations is required to account for the high inter-annual variability of dryland ecosystems. Long-term monitoring is indispensable for identifying changes in the inter-annual variability (that is, detecting climate change) and distinguishing the roles of human actions and climate variability in vegetation productivity.

69. Most of the countries in sub-Saharan Africa and Central Asia that have drylands lack a critical mass of scientists, engineers and other relevant experts, and have a woefully weak institutional capacity in science and technology. These countries must address this problem by increasing their investment in higher education and scientific and technological capacity. Bilateral donors and other funding providers should include science and technology capacity-building among their priority areas of development cooperation and increase the funds they allocate to this end.

70. There is concern in the scientific and technological community that the current process of providing scientific and technological advice for the implementation of the United Nations Convention to Combat Desertification is relatively weak. This weak link to the best available science and technology is a serious obstacle to the accelerated implementation of the Convention and the relevant chapter in the

Johannesburg Plan of Implementation. Consequently, concrete measures should be taken to strengthen the links between drylands research, long-term observations, scientific assessments and policymakers.

IV. Major international scientific endeavours

71. Sound policymaking and action for sustainable development, from local to global levels, in agriculture, land resource management, rural development, drought and desertification require the best available scientific knowledge. This can come only from research, long-term observations and scientific assessments. In order for the continuum, from research to developmental impact, to function effectively, strong links must be built between interdisciplinary research, long-term earth observations, scientific assessments and policymaking.

72. At the global level, agriculture and related issues are the focus of several international scientific endeavours, which together cover the continuum from research to scientific assessment and feed directly into policymaking bodies such as the Commission on Sustainable Development, the Food and Agriculture Organization of the United Nations and the United Nations Environment Programme; intergovernmental forums; multilateral environmental agreements and conventions, in particular the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity and the Convention to Combat Desertification; and regional intergovernmental bodies.

A. International interdisciplinary research

73. Two international research endeavours with global scope and relevance to this paper deserve particular attention: the Consultative Group on International Agricultural Research and the Global Environmental Change and Food Systems programme.

74. The first endeavour consists of the 15 international agricultural research centres supported by the Consultative Group. It was established in 1971 as a strategic partnership of countries, international and regional organizations and private foundations.¹ In collaboration with national agricultural research systems, civil society and the private sector, the 15 centres foster sustainable rural poverty reduction through high-quality science aimed at benefiting the rural poor through enhanced productivity, food security, better human nutrition and health, higher incomes and improved management of natural resources. The research portfolio of the Consultative Group Centres has evolved from the original focus on increasing productivity in critical food crops. Today's approach recognizes that sustainable development, environmental integrity and sustainable natural resources management, and policy research, to name a few, are essential areas of focus.

75. Major reforms of the Consultative Group on International Agricultural Research system, designed to strengthen science, streamline governance and maximize impact are gaining ground and yielding benefits, including the recent creation of the Alliance of the Consultative Group on International Agricultural

¹ See www.cgiar.org.

Research Centres for increasing programmatic and institutional synergies and strategic collective action. The innovative Challenge Programme initiative is designed to address global and regional issues of critical importance. To date, these focus on:

- (a) Combating micronutrient deficiencies that affect more than 3 billion people;
- (b) Addressing water scarcity by improving water-use efficiency in agriculture;
- (c) Unlocking crop genetic diversity by using molecular tools to create new varieties of major food crops that meet farmers' needs;
- (d) Employing integrated agricultural research for development approaches to build sustainable livelihoods in sub-Saharan Africa.

76. Global Environmental Change and Food Systems started in 2001 as a 10-year comprehensive programme of international interdisciplinary research focused on understanding the links between food security and global environmental change.² The research agenda is specifically designed to underpin policy formulation in this area. Global Environmental Change and Food Systems was launched by the Earth System Science Partnership, involving the International Geosphere-Biosphere Programme; the International Human Dimensions on Global Environmental Change Programme; the World Climate Research Programme; and DIVERSITAS.

77. Another relevant interdisciplinary initiative is the Global Land Project, a joint research effort of the International Geosphere-Biosphere Programme and the International Human Dimensions on Global Environmental Change Programme. The Global Land Project agenda focuses on understanding the interactions between people, biota and natural resources in a coupled human-environmental system. The Global Land Project is concerned with the implications of land use change and with the decision-making processes related to land use management.

78. Each of these international research programmes of global scale has different institutional sponsors. In addition to international scientific organizations, the World Climate Research Programme (the World Meteorological Organization and the Intergovernmental Oceanographic Commission of UNESCO), DIVERSITAS (UNESCO) and the International Human Dimensions on Global Environmental Change Programme (the United Nations University) have United Nations system organizations among their sponsors. The programmes all have one sponsor in common: the International Council for Science, ensuring that the activities are anchored in the scientific community concerned worldwide.

79. A particularly important collaboration is now emerging between the international agricultural research community (spearheaded by the Consultative Group and its partners in the North and South) and the worldwide global environmental change research community (spearheaded by the Earth System Science Partnership). Together, these two bodies possess the combined strengths and capabilities required to meet the research and capacity-building needs to develop more robust agriculture and food systems in the face of climate change. This new initiative is being developed as a Challenge Programme on climate change,

² See www.gecafs.org.

agriculture and food security of the Consultative Group and the Earth System Science Partnership.

B. Data needs and long-term terrestrial observations

80. Policymakers, land use planners, natural resource managers and research scientists, in particular those involved in the above-mentioned programmes, are seeking reliable data and information based on long-term observations of numerous parameters related to the topical areas covered by this paper. These data needs include: changes in land cover and land quality; availability of freshwater resources; loss of biodiversity; extent and impacts of pollution and toxicity; and impacts of climate change.

81. To meet these data requirements, FAO, UNESCO, WMO, UNEP and ICSU established the Global Terrestrial Observing System in 1996. The Global Terrestrial Observing System represents a "system of systems", formed by linking existing and new satellite remote sensing systems and in situ monitoring sites and networks. Progress in making the Global Terrestrial Observing System a truly operational system is woefully slow due to insufficient support at the global and national levels. For Governments and international organizations concerned, it should be a priority during the coming years to increase long-term observations of terrestrial environments by accelerating the implementation of the Global Terrestrial Observing System as part of the Global Earth Observation System of Systems.

C. Scientific assessments

82. Scientific and technological assessments play a crucial role on the continuum, from research and long-term observations to policy formulation and developmental impact. There are several major international assessments of direct relevance to agriculture, desertification and other issues being dealt with by this Commission on Sustainable Development biennial cycle.

83. The Millennium Ecosystem Assessment³ was the first state-of-the-art scientific appraisal of the condition and trends in the world's ecosystems and the services they provide — such as food, forest products, clean water and natural resources. The Millennium Ecosystem Assessment findings were published as a series of reports in 2005. The Millennium Ecosystem Assessment had an innovative governance structure that was representative of not only scientists and experts, but also of United Nations institutions and conventions, international scientific organizations, civil society groups, business and industry and indigenous peoples.

84. The main finding of the Millennium Ecosystem Assessment was that the major changes which have been made to ecosystems, mainly over the last 50 years, have contributed to net gains in human well-being and economic development. However, these gains have been achieved at ever-increasing costs: the degradation of many ecosystem services. These problems, unless addressed, will substantially diminish the benefits that future generations obtain from ecosystems. It is crucial for policymakers and practitioners to take action now to address these problems. It will also be important for the scientific and technological community, with support from

³ See www.millenniumassessment.org.

Governments and in cooperation with intergovernmental organizations both inside and outside the United Nations system to address the gaps in knowledge identified by the Millennium Ecosystem Assessment and establish a process for regular periodic global and regional ecosystem assessments.

85. The International Assessment of Agricultural Science and Technology for Development was a three-year collaborative effort (2005-2007) launched and co-sponsored by FAO, the Global Environment Facility, UNDP, UNEP, UNESCO, the World Bank and the World Health Organization, with a multi-stakeholder bureau which included representatives from Governments, agricultural producers, civil society, private sector and scientific institutions around the world (among them the Consultative Group on International Agricultural Research and the International Council for Science). The findings of this assessment will be available online during the first half of 2008.⁴ However, this paper was able to draw on early unpublished results.

86. The Land Degradation Assessment in Drylands partnership is geared towards developing and testing an effective assessment methodology for land degradation in drylands. The Assessment focuses on the status and trends of land degradation in drylands, including: biodiversity loss; identifying areas with the most severe land constraints and degradation (hot spots); and identifying areas where conducive policies and actions have slowed or reversed the degradation (bright spots). The partnership includes governmental agencies in countries concerned, United Nations system organizations and Convention secretariats, bilateral donors, non-governmental organizations, national scientific institutions and international scientific organizations.

87. The consultative process, initiated by the Government of France, towards establishing an International Mechanism of Scientific Expertise on Biodiversity was completed in November 2007. The process identified the need to improve the interface between biodiversity science and policy at global and sub-global levels, in particular the need for proactive scientific expertise on emerging threats and issues associated with loss of biodiversity. Consequently, the International Mechanism Steering Committee has invited UNEP to convene an intergovernmental meeting in collaboration with the Government of France, other governments, the Convention on Biological Diversity and the partners of the International Mechanism consultation process to consider establishing an efficient science-policy interface mechanism on biodiversity.

V. Education, training and institutional capacity-building in science and technology

88. Achieving the Millennium Development Goal of universal primary school education will be crucial for enhancing rural development; sustainable agriculture and management of natural resources; mitigating the impacts of drought and combating desertification; and poverty reduction, particularly in developing countries. It is especially important to ensure that girls and young women receive high quality education, given their current under-participation in basic education and in scientific and technical courses at all levels.

⁴ See www.iaastd.org.

89. Education for farming and pastoral communities must be made more context- and problem-specific. In particular, investment in occupational education and learning opportunities for small-scale farmers which are also accessible and relevant to traditional and indigenous people must be stepped up in developing countries. The more widespread application of collaborative approaches in agricultural knowledge, science and technology practices would require: complementary investments in the education of agricultural knowledge, science and technology technicians and professionals in order to strengthen their understanding of and capacity to work with local and indigenous individuals and communities; and support for developing curricula that value and provide opportunity for field-based experience and apprenticeships under the educational guidance of the communities.

90. There is a need to:

(a) Give higher priority to agro-ecological and integrated approaches in primary through tertiary education and research;

(b) Invest in a broader range of social sciences to understand and help design solutions to power asymmetries in agricultural knowledge, science and technology and arrangements for effective encounters between knowledge implementers and knowledge organizations;

(c) Make an active effort to extend connectivity and information and communications technologies to traditional and local knowledge players.

91. The United Nations Decade of Education for Sustainable Development 2005-2014 is a major instrument for reorienting education for rural communities. Agriculture, sustainable land and water management and drought and desertification should receive particularly high attention within different domains of education, including basic and higher education, specialized training and developing public awareness and understanding of sustainability. The scientific and technological community is committed to making an active and important contribution to the Decade in this respect.

92. Building and maintaining the quality of key national institutions of learning and research, especially universities, is critical to sustainable development. The responsibility for this capacity-building lies squarely on the shoulders of national Governments. However, the global development assistance community and the international scientific and technological community should enhance collaboration and partnerships with developing countries in this field. Experience shows that international scientific and technological cooperation, through efforts such as the creation of scientific and technological networks, scientific exchanges and the establishment of scientific centres of excellence among nations with weak scientific infrastructure, are excellent strategies for building scientific and technological capacities. At the same time, coordinated measures must be taken to counter the negative effects of "brain drain" upon countries that are working to develop their own scientific and technological community and institutional capabilities.

93. Bridging the widening gap in scientific and technological capacity between developed countries and the majority of developing countries is particularly critical in agriculture, natural resource management, combating desertification, addressing climate change and poverty reduction. Developing countries must address this problem and significantly increase investment in higher education — natural, social,

engineering and medical sciences — and in research and development institutions dedicated to the above topical areas.

VI. Conclusion

94. Progress in meeting sustainable development goals in the areas under review at the sixteenth Commission on Sustainable Development session will require substantial innovative advances in science and technology. Massive efforts will also be required to involve farmers and other stakeholders in scientific and technological agenda-setting; to strengthen the scientific and technological capacity in developing regions that still lack this capacity; and to get improved knowledge, approaches and technologies to the farmers (in particular small-scale farmers who could benefit most) to other natural resource managers, policymakers and development agencies.

95. Science and technology for sustainable development must be global in its reach, yet local and national in its application. Enhanced North-South and South-South scientific and technological cooperation, knowledge networking and dissemination, and technology transfer will be essential for ensuring a better harnessing of science and technology in agriculture and the other areas under review.

96. The scientific and technological community remains committed to helping identify and implement sustainable solutions to the pressing problems of food security, poverty reduction, maintaining ecosystem services and climate change. To this end, our community seeks to enhance further cooperation with Governments, farmers, business and industry, and all other major groups in the pursuit of a sustainable path of development.

**Economic and Social Council**

Distr.: General
10 January 2008

Original: English

Commission on Sustainable Development

Sixteenth session

5-16 May 2008

Item 3 of the provisional agenda*

Thematic cluster for the implementation cycle

2008-2009 — review session

Discussion papers submitted by major groups**Note by the Secretariat****Addendum****Contribution by farmers******Contents**

	<i>Paragraphs</i>	<i>Page</i>
I. Introduction	1-7	2
II. Challenges and main issues for farmers	8-52	3
III. Review of implementation: analysis of progress and successful experiences	53-97	10
IV. Lessons learned and new opportunities to expedite implementation	98-101	18

* E/CN.17/2008/1.

** This paper has been prepared by the International Federation of Agricultural Producers. The views and opinions expressed do not necessarily represent those of the United Nations.



I. Introduction

1. All the issues being addressed by the Commission on Sustainable Development at its sixteenth session are closely linked to the sustainability of agriculture and to the livelihood of farmers. Thus the development of agriculture is an essential driving force for both poverty reduction and for rural development. Agricultural production practices are a key factor in the sustainable management of natural resources, since farmers are the custodians of much of the Earth's land and freshwater resources. Nowhere are these issues felt more acutely than in Africa and small island developing States. The Farmers' Group is therefore very pleased to see that agriculture is back on the agenda of the Commission, to review progress and measure challenges and obstacles for the first time since the eighth session of the Commission.

2. The *World Bank Development Report 2008*, the first on agriculture since 1982, highlights the importance of agricultural development as key to reducing poverty and as an engine for economic growth and rural development. The World Bank report rightly notes that while 75 per cent of the world's poor live in rural areas and depend on agriculture, only 4 per cent of overseas development assistance and 4 per cent of the budgets of Governments of Africa go to agriculture. Farmers think that this is an unsustainable situation. This trend should be reversed; agriculture should be given the priority it deserves so that it can fulfil its potential in sustainable development.

3. On an economic level, agricultural productivity in many parts of the world has increased owing to technological improvements. New actors are emerging in the form of an agri-food system dominated by multinational enterprises, which can source raw material and sell products any where in the world. This development has been facilitated by both technological changes and policy measures that promote free movement of services and capital.

4. In spite of these changes, food insecurity still remains a huge challenge (more than 800 million people remain food insecure). High population growth and increasing income growth and energy needs are the main drivers of this trend. This puts additional pressure on natural resources, with land and water as main assets for farmers being put under pressure and becoming increasingly scarce. As a result, commodity stocks, such as cereals, are at their lowest levels in 30 years, and commodity prices have risen sharply. Energy supply shortages have led to a peak in fossil fuel prices, and increased production of biofuels using agricultural commodities is one response.

5. Agricultural development and environmental protection have become tightly linked. All over the world, climate variability, associated with climate change resulting from human actions, is leading to an increase in the frequency and intensity of floods, droughts and desertification.

6. This situation leads to a multifaceted unsustainability on the social, economic and environmental levels. The solution to this problem lies in the implementation of a new agricultural model in which farmers contribute as real entrepreneurs, be it through the development of more sustainable agricultural practices to manage water in an efficient way, to fight desertification and drought through sustainable land management techniques, and by getting organized in the marketplace and

developing high-quality products in order to respond to increasing consumer demand.

7. Nevertheless, farmers and agriculture are faced with several challenges which urgently need to be overcome. These challenges include: attracting investments in agriculture for rural development, in particular in arid and semi-arid zones which are most affected by desertification and drought; raising awareness of the importance of environmental protection; creating adequate rural services to serve rural communities; improving the livelihoods of farming families through returns from the market and rewards for services rendered to nature in the form of stewardship programmes.

II. Challenges and main issues for farmers

8. Given the context described above, one of the biggest challenges for sustainable agriculture and rural development is the setting up of a farming approach which encompasses environmental sustainability and the provision of better incomes for farmers, including reduced costs of production, higher quality of products and improved yields. The balance between environmental, economic and social development, namely the three pillars of sustainability, is thus critical if the Millennium Development Goals to reduce poverty and hunger are to be met.

A. Agriculture

1. A new approach to agriculture and rural development

9. The situation of rural populations and farmers has not improved significantly because most of the existing agricultural strategies are not working well. However, recently there has been a shift in global policy thinking towards the recognition of agriculture and rural development as the drivers of economic development. This means that there is a need for a new approach to agriculture and rural development based on the productivity, profitability and sustainability of farmers, in particular smallholders. Any successful agricultural and rural development strategy requires investment in small farm agriculture so that subsistence farmers become small-scale entrepreneurs and not migrants to overcrowded cities. At the same time, this new approach has to redefine the role of the different stakeholders, mainly public authorities, farmers' organizations, the private sector and the scientific community. For the past few years, progress has been made worldwide in terms of participatory policy regarding non-State actors, including farmers. The latter are becoming better organized in the form of cooperatives and unions, and so are better able to make their voices heard in decision-making and acquire profitable access to markets. However, many farmers' organizations, in particular in developing countries and particularly in Africa, still need capacity-building to achieve this goal. This represents one of the biggest challenges facing the new approach to sustainable agriculture and rural development.

2. Reducing the cost structure of agriculture: a key to farmers' profitability

10. The recent upward trend in commodity prices is perceived as a positive development for most farmers. A steady and sustained increase in commodity prices

should enable farmers to sustain agricultural production and improve their productivity and income, as well as the vitality of rural communities after 40 years of depressed agricultural prices. This new situation opens up opportunities for investment, especially in developing countries. Prices for meat and dairy products also need to rise in order to cover the higher prices for animal feed that present severe financial difficulties for livestock farmers. Nevertheless, farmers are well aware of the adverse effects on consumers of higher foods prices and the need for Governments to address this problem.

11. This positive trend should not mask a significant burden borne by farmers: agricultural costs. Farmers' profitability does not depend solely on the level of commodity prices. Keeping production costs low is also a key to profitability and, therefore, the sustainability of agriculture. Among those costs are those related to meeting government regulations, certification and the conservation of natural resources.

Costs related to government regulations

12. To address the costs related to meeting and implementing government regulations, estimated at over 360 million euros per year, in 2006 the Federation of Swedish Farmers published a document entitled "Why make it so difficult". The document demonstrates that the rural sector in Sweden has to deal with 400 different regulations and more than 800 documentation obligations. The Federation of Swedish Farmers has invited its Government to set a strategy to reduce the burden of complicated rules and regulations in the agricultural and forestry sector by 40 per cent by 2010.

Costs related to meeting high food safety and environmental standards

13. Farmers are required to face higher and higher standards, for example, for animal welfare or the environment, and increasing demands for documentation and traceability from risk managers, both in Government and in the retail sector. These requirements involve significant extra costs which often fall disproportionately on farmers compared with other actors in the food supply chain.

Environmental costs

14. Getting farmers to change and adapt their farming practices to protect the environment induces extra costs. Farmers living in areas where food security and resources are scarce lack financial capital and often cannot afford to invest in new sustainable practices. For example, switching from traditional till agriculture to a more environmentally friendly farming practice, such as conservation agriculture, may result in decreased crop yields for the first few seasons while farmers perfect their techniques. However, in the long run, the gains in the form of climate change mitigation and productivity of the land will pay off. Unfortunately, there is often a conflict between long-term investment in sustainable agriculture practices and short-term food security.

15. Farmers are unable to bear those costs on their own. They need incentive measures to be able to share the costs. There is also a significant potential for increased costs for farmers related to taxation measures that are enacted to meet climate targets.

Certification costs

16. Farmers worldwide are involved in a wide variety of voluntary certification schemes ranging from environmentally friendly to quality assurance schemes. Most certification schemes originating from developing countries are for export markets. Therefore, demand is driven by developed countries. Certification schemes certainly represent a way for farmers worldwide to diversify their outlets and access new markets, even though they represent niche markets with fierce competition.

17. Farmers' involvement in those schemes induces additional costs that are due mainly to high administrative costs, investments in new equipment and audits on the farm. Another important barrier for farmers is their limited bargaining power, because those products are directed to a specific segment of consumers. Also, additional costs related to compliance with these schemes represent a disincentive for small-scale farmers.

18. Finally, many farmers feel that the prices received from those products are not high enough to cover production costs. Farmers need a balance between costs and revenue to make it worthwhile for them to continue farming.

3. Access to appropriate technologies

19. In developing countries, facilitating access to appropriate technologies and upgrading existing ones is critical for the sound management of natural resources, including land and water. For example, to successfully combat desertification and drought, adapted farming technologies are needed for dry land farmers to maximize earnings from their lands while protecting them and capitalizing on the presence of basic infrastructure and support services. Support from developed countries is essential, especially in terms of knowledge-sharing and transfer of technology.

B. Rural development

20. A successful rural development strategy needs to look at all assets of rural development, namely, natural, social, physical human and financial capital. Rural development must be centred on people, must have an integrated territorial perspective and must involve long-term strategies for which adequate resources are earmarked.

1. Providing adequate services and infrastructure in rural areas

Inadequate rural services

21. Often, rural areas do not enjoy the same level of services as those available in cities. Inadequate access to such services as education, health, banking and credit facilities, and electricity, water and transport infrastructure represents a serious impediment to agriculture and rural development. This lack of support represents a cost on farm households.

22. In Nepal, despite many efforts to provide rural areas with adequate services, a weak institutional framework is holding back sustainable development in these areas. This weakness is the result of poor training and lack of empowerment of human resources. In order to carry on this development and make it sustainable, the issues of weak management capacity, lack of training on capacity and leadership

building, business knowledge and training on capacity-building and gender equality must be addressed.

Poor infrastructure

23. Rural infrastructure, for example water and irrigation systems, energy supply, roads, market information and telecommunications, remains inadequate in many developing countries. Such inadequacy is therefore a major constraint to competitiveness and the profitability of agriculture and rural development. This disinvestment is due to inadequate funding for and government withdrawal of the provision of needed infrastructure.

2. Creating rural employment

24. If rural areas are to become a driving economic force, jobs have to be created both in the agriculture and rural non-farm sectors. For this, a good investment climate needs to prevail, for example, through investing in infrastructure, linking the local economy to broader markets, providing services to functioning markets and linking farmers to the marketplace so that they can become real entrepreneurs.

3. Farmers' organizations and increasing farmers' market power

25. The globalization and liberalization of markets have led to the emergence of new players in the value chains for agricultural products. Demographic factors, particularly urbanization in developing countries, have influenced consumer preferences, which in turn have had an impact on domestic markets and supply chains. Parastatals have been replaced by multinationals and local private traders in the agricultural export trade and input distribution, while supermarkets and large-scale retailers are becoming increasingly important in both developed and developing countries. The role of other players, such as farmers' organizations, in assisting agricultural producers to improve market access and to enhance the bargaining position vis-à-vis suppliers has also grown.

26. The potential of farmers' organizations to provide economic benefit to their members is to a large extent determined by the institutional environment of the organizations — policies, rules and regulations. Therefore, proactive advocacy activities are needed in order to adjust the institutional environment to the farmers' needs.

27. The advocacy efforts of farmers' organizations tend to face two challenges:

(a) First, many policies related to the institutional environment in which farmers access agricultural markets are generic and do not consider the specific features of smallholder farming and their forms of economic organization. The adapted policies should include those related to competition and taxation, as well as risk mitigation mechanisms;

(b) Second, marketing strategies developed by farmers to cope with these challenges in the market are no longer feasible within the existing institutional environment. Farmers' organizations have to restructure and reposition themselves in this changing market system. Examples of practical experiences of other farmers' organizations in developing innovative institutional arrangements and policy initiatives that cope with the challenges of the modern agri-system are an important source of learning in that adaptation process.

The critical role of small scale farmers in developing countries

28. Smallholders are in an even more difficult position than other farmers. In most developing countries, smallholder farming is important for poverty reduction, food security and the rural economy more widely. The majority of the rural population in sub-Saharan Africa can be considered as smallholders. Their importance derives from their prevalence, their role in agricultural and economic development and the concentration of poverty in rural areas. Most smallholders are vulnerable to economic and climatic shocks and spread their risk by diversifying their sources of livelihood, which often include significant off-farm income. Complete subsistence or self-sufficiency rarely exists, as there is often some form of local market in which smallholders trade their surplus. But those markets are not very remunerative and offer limited opportunities for price negotiation. Finding and entering markets with better prospects is difficult.

4. Bioenergy, a promising tool for rural development

29. For farmers, bioenergy represents a new market and a way to diversify risk. Farmers in developed and developing countries see those benefits as an opportunity to keep expenditures on energy within the domestic economy.

30. Despite promising prospects, there is a need to analyse the real effect of bioenergy development on producers' incomes.

31. Sustainable energy sources are developing fast; yet, they have a low rate penetration into the agricultural sector because they represent challenges for farmers. These include: early adaptation of technologies; geographic location; high capital costs; and cost competitiveness with traditional sources of energy.

32. Farmers want to benefit from this promising outlet by becoming providers of value added products instead of producers of raw materials and buyers of energy. Farmer ownership is key for bioenergy production as a means of improving income and reaping some of the benefits that are going to large multinationals.

C. Land**1. Land, a critical asset for farmers**

33. Secure land tenure arrangements for farmers are critical to the sustainable development of agriculture. They give farmers strong motivation to manage and protect the land through improved agricultural practices. Secure land tenure also provides collateral for farmers to obtain farm credit. Therefore, any rural development strategy has to include secure access to land for farmers (land titles), including for women farmers, who have a particular problem in this regard.

34. Soil condition is also a prerequisite to sustainability from both an environmental and an economic point of view, and underpins long-term sustainability and productivity of the land.

2. Limited access to and high concentration of land

Lack of clear legislation

35. In many countries, in particular in Africa and Latin America, land access and concentration is becoming an increased concern and a threat to the survival of farmers.

36. In the Democratic Republic of the Congo, farmers access land through either inheritance or purchase. This creates significant fragmentations of land distribution between large and very small landowners. Access to land is a way to social differentiation and is a source of poverty in rural areas. The inheritance system is complex and follows customary rules. The national law, which is inspired by European legislation, regulates land tenure, but is ignored by large portions of the farming community. This dual system engenders sociocultural, political and economic conflicts over land access and ownership in the country. Women farmers do not have as equal access to land as their male counterparts.

37. The Syndicat de défense des intérêts paysans, a regional farmers' organization in northern Kivu, provides a range of services to individual farmers to help them solve conflicts over access to land. Its main activities include: legislation support and advocacy of farmers' interests; training of advisers; translation of legislation into Swahili; and codification of customary tenure.

38. Therefore, action is needed to secure land titles for farmers, as the impact on farm activities and farmers' motivation is significant.

Intensive use and high concentration of land

39. The price of land is rising in many parts of the world which in turn leads to an intensification of its use thanks to technological changes. The sustainability of such practices, as observed in Uruguay and Argentina, must be questioned.

40. A handful of large enterprises and emerging new actors (often foreign investors as agricultural contractors) control the factors of production. This situation has generated a fundamental change in terms of market security, liquidity and uncertainty on investment planning. As a result, small- and medium-scale farmers have been pushed off their land.

D. Desertification

1. Desertification is a development issue

41. Combating desertification and land degradation is probably one of the most important challenges for the years to come. Land degradation in arid areas affects approximately 2 billion people living in arid zones, including in the North. Without fertile soil and without tools for sustainable land management, those living in these regions are unable to break out of the cycle of poverty.

42. The recognition of the link between poverty and land degradation during the World Sustainable Development Summit in Johannesburg in 2002 is encouraging. Furthermore, the geography of poverty often coincides with that of drought, desertification and land degradation.

43. Agriculture can be either an aggravating factor in desertification or a corrective factor resulting in improvement of the land. Desertification and food security are intrinsically linked. In fact, desertification is one of the causes of lack of food security, leading to socio-economic and political tensions. Farmers are among the first victims of the phenomenon of desertification, as natural resources, such as fertile topsoil, organic matter, plant cover and healthy crops, are the most severely affected by desertification.

44. The process of land degradation essentially affects arid land, and approximately 70 percent of the 5.2 billion hectares of arid land devoted to agriculture is degraded. For farmers, desertification is not a concept but a question of day-to-day food security. In the past, those responsible for development projects did not or hardly involved the people affected by the phenomenon of desertification in their projects to combat the problem. However, the local population, in particular farmers, often knows more about weaknesses in the ecosystem and holds information that is key in countering the effects of desertification.

45. There is little available information about farmers' experiences in combating desertification. It is therefore difficult to evaluate the real consequences of desertification in the agricultural sector. All the same, farmers are fighting the problem on a daily basis to ensure their own survival. Nevertheless, in addition to the use of appropriate techniques, efforts to combat desertification should be accompanied by integrated measures that encourage economic and social change and should be an integral part of the development process.

2. Combating desertification through strong farmers' organizations

46. Combating desertification is not just about adopting sustainable farming practices through innovative and adapted techniques. It is all about getting farmers and rural communities to turn dryland areas into real assets. For this change to happen, strong organized farmers and rural community groupings that will take their destiny in their own hands are needed. Dryland farmers can best capitalize on their limited resources by forming strong rural organizations that exercise sociopolitical and economic functions and provide various services (training, information and extension).

3. Marketing schemes as an effective way to combat desertification

47. Since dry lands are inherently less productive and fertile, the challenge lies in increasing the market value of crops to offset their lower productivity and higher costs of production. Dryland products can be differentiated from ordinary produce, and therefore marketed at a higher price through unique production and processing methods, attractive packaging and innovative marketing techniques. Contract growing or forward selling under mutually beneficial terms are prone to provide the security and incentive for farmers to invest and pursue the production of specific crops. However, given that the small scale and marginal levels of production can make farmers in these areas vulnerable to markets, climatic and other external factors, dry land farmers should be encouraged to diversify their crops and income sources. Rural livelihood programmes such as simple food processing and small-scale manufacturing, among others, are critical to supplement farm incomes. These programmes should incorporate sustainable and remunerative marketing schemes instead of stop-gap social welfare support activities.

4. Turning dry and degraded land areas into economic assets

48. Lack of investment and economic growth represent significant challenges. In order to convince policymakers to invest in agriculture and natural resource management in dry lands and degraded areas, it is necessary to translate the different impacts of natural resource management investments in monetary terms (that is, increase of the biomass, higher levels of water in wells and recapitalized land) and in documenting success stories. Relevant data should be compiled to convince policymakers on the economic benefits of regenerating the land. This will help break the image of drylands as being substandard and turn them into real economic assets.

E. Drought, water and climate change

Adapting to weather variability through risk management tools and insurance schemes

49. Climate variability brings widespread weather events that affect entire communities. Traditional insurance markets and informal insurance arrangements between farmers and community members in developing countries are inadequate to prepare for climate change. Farmers who try to self-insure themselves through the accumulation of assets, savings and access to credit may have just as much trouble at the onset of a crisis, as those measures are often insufficient and may be easily damaged. For example, at the onset of a flood, physical assets, such as property and land, may be damaged, while community financial aid will be stressed as a result of the widespread effects.

50. Risk-management tools are often lacking, in particular in the developing world, to support farmers in facing the effect of weather variability.

51. However, many farmers in developed countries benefit from such schemes in the form of insurance or safety nets. In Austria, farmers benefit from a mutual insurance association system by the name of Austria Hail Insurance. This system includes risk-management coverage for agricultural systems. Farmers pay 50 per cent of the insurance premium, and the remainder is provided by the provinces (25 per cent) and the Federal Government (25 per cent).

52. Following the drought in 2003, the European Union (EU) allowed national Governments to provide compensations for farmers who faced losses induced by the drought, within the limits set by EU regulations.

III. Review of implementation: analysis of progress and successful experiences

53. Farmers render a wide array of services to nature without being remunerated for doing so. These include: production of high-quality products, shaping attractive landscapes, provision of environmental services and maintenance of rural areas. Some countries have developed stewardship programmes to fill this gap.

A. Agriculture and rural development

1. Rural development as an engine of economic development

54. In Europe, rural areas have undergone significant changes. The promotion and development of rural areas make up the second pillar of the new Common Agricultural Policy. Rural development is important for promoting diversification and innovation in rural areas beyond agricultural activities as such. The LEADER programme is one of the EU structural funds designed to help rural communities to enhance the potential of their local regions. It encourages the implementation of integrated, high quality and original strategies for sustainable development. The LEADER programme contributes to rural employment, income improvement and the creation of new opportunities.

2. Women as the driving force for rural development

55. In developing countries, 80 to 90 per cent of the food supply is produced by women. Women are a critical factor in rural development, and their economic empowerment is essential to address poverty and food insecurity. However, women farmers are one of the most vulnerable groups, often lacking access to resources, land, water, education and training, credit and market opportunities. Their active involvement in decision-making processes is often lacking.

56. The Chambers of Agriculture in Austria, for example, have taken measures to improve women's participation in agriculture and rural development through specific training arrangements and targeted extension services.

57. The success of a rural development policy stems from the sharing of responsibility between farmers of both genders. This represents a real challenge.

3. Farmers deriving benefits from high-value market products

Direct marketing of local products

58. This concept is gaining importance, for example in Austria, where 21 per cent of the farmers take part in the direct marketing programme which promotes "the farmer's delicacies". These activities lead to building the capacity of all market partners involved, including farmers, innkeepers, butcher shops, trade and Alpine dairy farms.

59. Direct marketing of products presents the following benefits to the farmer: decreased risk, direct consumer contacts, production of specialized products and the promotion of regional identity.

Certification schemes

60. Farmers' involvement in certification schemes allows them to improve the quality and reliability of their products. Sometimes, certified products provide higher competitiveness against imported products, for example good agricultural practices certification and organic products.

61. Certification schemes are also providing farmers with an increased bargaining power in the food supply chain along with an improved relationship with buyers, processors and retailers. For some farmers in developing countries, getting involved

in certification schemes is a way to ensure market access (export markets mostly), as the production is often under contract, for example coffee producers in Uganda.

4. Linking farmers to the market for rural development and income generation

Enhancing the economic potential for improved incomes in dryland communities in Uganda: an integrated approach

62. The marketing of goods and services is difficult in Uganda since 80 per cent of the population lives in rural dry areas. The Uganda Cooperative Alliance created locally based area cooperative enterprises to fill the gap left by the collapse of cooperative unions in the 90s. The Uganda Cooperative Alliance designed a marketing channel that enables organized producers to take advantage of liberalization (of new products and markets). The system is rooted in the private sector, and it is designed in such a way that protection is provided to the producers because they are linked to different channels.

63. In the new cooperative system, four new institutions were designed to meet member needs in a changing environment. These include the Area Cooperative Enterprises formed by 5 to 10 producer cooperative societies within a geographical area. The Area Cooperative Enterprises act as brokers in providing services by using the capacity provided by input suppliers, private processors and producer buyers. This system integrates five players: savings and credit cooperatives (microfinance institutions), input dealers, Area Cooperative Enterprises, primary societies and the farmers.

64. After six years, this system has delivered positive results, that is easier availability of credit and other financial services (60 per cent of the loans advanced by the savings and credit cooperatives were for agriculture), higher producer prices (22-57 per cent higher than those selling out of the system), and increased food security (70 per cent of the farmers benefiting from the projects have three meals a day).

65. Through this integrated approach, farmers have been empowered with skills, bargaining power, affordable financial services and decent incomes.

Cooperatives maintain farmers' livelihoods

66. Agricultural cooperatives are significant economic and social actors. More than 800 million people around the world belong to agricultural cooperatives. They provide 100 million jobs worldwide, which is 20 per cent higher than the number of jobs provided by multinationals. Agricultural cooperatives provide a wide range of services to their members through: better prices for the purchase of agricultural consumables; economies of scale; provision of better market prices, and safe and high-quality food; and generation of added value throughout the value chain. Agricultural cooperatives in Uruguay, for instance, have been instrumental in bringing horizontal and vertical integration of small- and medium- scale farmers.

5. Payments to farmers for ecosystem services

67. Farmers need incentives to encourage them to use more environmentally friendly production techniques and thus to improve their ecological footprint. Environmental sustainability has to work for farmers and not only for Governments or society as a whole.

68. Governments in developed countries, as well as in some developing countries, have put in place stewardship programmes for farmers to reward them for: protecting and enhancing agricultural biodiversity through the adoption of more sustainable agricultural practices, for example land use, water management, carbon sequestration, sustainable use of energy sources and sustainable management of forests; valorizing marginal areas; and producing traditional species to prevent the loss of genetic resources.

Carbon exchange system benefits farmers in the United States of America

69. Farmers in the United States of America have developed a unique instrument in the form of a carbon credit programme, which allows them to earn income through agricultural conservation practices, such as no-till farming. By doing so, farmers can do more than save fuel, soil and water; they can earn money. The National Farmers Union of the United States of America has the approval of the Chicago Climate Exchange to aggregate carbon credits and sell them on the exchange on behalf of the producers.

*Promoting payments for ecosystem services in developing countries:
agroforestation in the Philippines*

70. Natural resources worldwide are under pressure, especially in fragile ecosystems that are located mostly in developing countries, which urgently need to be rehabilitated, for example arid zones. Given the lack of resources of Governments in most of those countries, farmers do not perceive the direct advantage of adopting sustainable production systems. However, some developing countries have made the effort to pay farmers for such services.

71. In the Philippines, local chapters were able to secure long-term leases and stewardship contracts from the Government to use logged over areas. With minimal technical assistance, they were able to reforest those areas at almost no cost to the Government. This approach is more sustainable than the typical approach, whereby Governments would pay private companies and non-governmental organizations to reforest barren areas, where little is done to sustain the trees once they have been planted and the contracted parties have been paid. In the case of community-based reforestation projects, farmers see the benefits of growing trees. All they need is to be given security over their lands, technology and planting materials.

6. Raising awareness of the importance of agriculture

72. Farmers' organizations are key players in raising awareness of their members of the importance of environmental protection and sustainability. This education process is critical if effective change in farmers' behaviour and rural communities is to occur. In Brazil, for example, the national farmer organization, the Brazilian Confederation of Agriculture and Livestock, has developed awareness-raising programmes on environmental protection aimed at providing training sessions to young farmers on the necessity to link agriculture and environmental protection. The Brazilian Confederation of Agriculture and Livestock is also actively involved in discussions with relevant ministries in the elaboration of legislative instruments to improve natural resource management.

The Australian National Farmers' Federation lobby campaign changes misconceptions on farmers and the environment

73. The National Farmers' Federation undertook an extensive lobby campaign aimed at getting the Government of Australia to implement and fund an environmental stewardship initiative. Indeed, stewardship — paying farmers to deliver environmental outcomes — has been a policy priority for the National Farmers' Federation since 1998.

74. The campaign aimed at inducing a major shift in public policy on two fronts; the perception of farmers as sound environmental managers, and breaking short-term government funding cycles to enter 15-year market-driven contracts with farmers.

75. Market research, political and environmental group engagement, membership cohesion and public repositioning of farming and the environment through media communication campaigns were pivotal in generating recognition of the modern environmental record of farming and leveraging this into support and action.

76. The National Farmers' Federation lobby campaign managed to overcome negative perceptions and misconceptions about farming's environmental credentials and established recognition of its responsible environmental management. It delivered up-to-date information on farmers' achievement in protecting the environment through sustainable agricultural practices.

Farm holidays and school on farm in Austria

77. About 8 per cent of Austrian farmers are involved in tourist activities. They offer tourist accommodations and make up one fifth of tourist enterprises. Two thirds of the farmers involved in tourism live in mountainous regions. Thus, farm holidays represent an important economic segment of the agricultural and tourist sectors and an important source of income for rural areas. The Austrian chambers of agriculture and the Ministry of Agriculture are involved in the provision of educational programmes for farm holiday entrepreneurs.

78. School on the farm has become a tool for many Austrian farmers to inform and educate teachers and pupils about farming. Recognition of the farm as a place to learn about nature and life, the promotion of agriculture as a way of life, and the promotion of the relationship among agriculture, food production and the environment, are among the main objectives of the schools, which have had a positive educational impact, while complementing the income for farmers and their families.

7. Farmers setting research priorities

79. For farmers, research findings should contribute to improving the livelihoods of their families and consequently to achieving the Millennium Development Goals. Research for development is fundamental to the modernization of agriculture and the improvement of the economic and health situation of rural people. Even though the system does not work in most countries, positive experiences exist worldwide.

80. In Argentina, the National Institute of Agricultural Technology includes representatives of the four main farmers' organizations within its governing structures. Their participation ensures that the work of the Institute is focused on

farmers' needs. The Institute also has a strong focus on extension to bring the results of its research to farmers' fields. In Uruguay, also, farmers' organizations are represented on the board of directors of the National Research Institute for Agriculture and on regional advisory committees and working groups. Farmers contribute to the funding of research through a small levy on farm products at the first point of sale. Such close cooperation between public research institutes and farmers' organizations has long been established in industrialized countries, such as Denmark, where the Agricultural Council is an integral part of the Danish research and extension system, with farmers also contributing to research through commodity levies. Such cooperation is relatively recent in Africa and still lacking in Asia.

81. It is critical that applied research systems open up to farmer participation at all levels to facilitate the adoption of and access to sustainable technologies and practices. Mobilizing political will around the involvement of farmers' organizations in setting research priorities and disseminating results to their members would be a significant step on the road to achieving the Millennium Development Goals.

B. Land, water, drought, desertification and climate change

1. Appropriate environmentally friendly agricultural practices to increase productivity

Combating desertification through agro-ecology

82. The agro-ecological approach seeks to achieve sustainable agricultural development through adopted techniques, taking into account environment and cultural aspects. Agro-ecology includes such agricultural practices as limited or zero-tillage, cultivation of plant cover, incorporation of plant residue in soil, and direct seeding of plants through plant cover. Those conservation techniques restore soil fertility, reduce pollution of water sources, increase the proportion of carbon retained in the soil and slow water and wind erosion.

83. Farmers worldwide often adopt those techniques for environmental and economic reasons. The zero-tillage technique has been tested in Cameroon and Haiti. A number of farmers, including wine producers in South Africa, use legumes to enrich and protect the soil. Intercropping is becoming more widespread and is used extensively in orchards and around other fruit trees, especially in Pakistan and Egypt, when the trees are young. In Guinea, peanuts and green beans are grown with potatoes. Corn is often grown with other types of crops, in particular in Madagascar, Benin, the Comoros and Côte d'Ivoire.

84. In Argentina, the technique of direct seeding has become widespread among farmers, as 70 per cent of the agricultural cultivated surface uses this system. Direct seeding is a cropping system that aims to improve soil and soil moisture conservation.

Combating desertification through agro-forestry

85. Agro-forestry combines and integrates agricultural and forestry methods to form an agro-ecosystem. Planting crops in woodlands where even livestock can graze allows for an optimum use of resources. Vegetation in forested areas thrives next to banana trees in the Comoros and cacao trees in Cameroon. Agro-forestry leads to an integrated, sustainable, productive and profitable management of soil

resources. In addition to contributing to soil amendment and the preservation of moisture, trees or bushes represent a source of energy. In Bangladesh, for example, farmers plant turmeric in between trees and, like farmers in the Caribbean, they plant young trees along roads and rivers. Agro-forestry is favoured by many farmers worldwide. In order to make known this practice and encourage its implementation, demonstrations and on-site visits are being organized in Kenya.

2. Participatory water management schemes

86. Water management remains an important concern for many farmers in the world. Integrated water resource management is being widely recognized as a promising possibility, going beyond the mere technical approach.

Water and soil conservation programme in Nicaragua

87. Over the past two decades, logging operations, the expansion of agricultural land and the indiscriminate use of chemical products, such as pesticides, herbicides and fertilizers, have seriously deteriorated the natural resource base, including water and land. Desertification has led primarily to significant soil erosion. In response to this situation, the National Union of Farmers and Ranchers initiated the programa campesino a campesino, an innovative programme offering small farmers various sustainable and economically viable technologies. The practices focused on tailor-made solutions for farmers using local resources and conditions. The programme seeks to encourage active participation by rural communities and the transfer of know-how, and proposes simple, inexpensive and effective practices. These techniques encourage the reuse of biological matter by limiting reliance on chemical inputs and other energy-intensive technologies. In addition, this approach makes it possible to reduce long-term production costs, although the projects are initially labour intensive.

Improving irrigation facilities: the case of Palestinian farmers

88. Palestinian farmers suffer from the lack of efficiency of their irrigation systems, which leads to significant water losses and to increased production costs and, in turn, to a decrease in their incomes.

89. To overcome this situation, the Palestinian Farmers Union has implemented a project with the support of French Development Cooperation. The objective was to demonstrate the usefulness of upgrading irrigation systems in terms of water savings and income improvement. The project benefited 50 pilot farms located in the largest irrigated perimeter in Jericho, and included a training programme targeting 100 agricultural technicians and 400 individual farmers. This has resulted in significant water savings (on average 36 per cent). It was decided to scale up this project and replicate it in other regions, but an expert study concluded there was a need for a strong water authority to change distribution systems in order for this replication to be sustainable. The experience of the Palestinian Farmers Union in organizing water users (including farmers) has proved essential to the success of this project.

Demand-driven water management: farmers in India acting as responsible users

90. In semi-arid areas in India, where water is scarce, farmers took the decision to grow fruits instead of water-consuming cereal crops and to measure rainwater on a daily basis. They also decided upon the timing of sowing and harvesting. These

decisions led to qualitative changes in farmers' lives. As a result, this responsible way of managing water resources has prevented the depletion of groundwater, has slowed down the drying of tube wells and has accelerated the process of recharging aquifers. These efforts, initiated by the farmers themselves, need to be replicated at the national level. With proper education and information, change can occur on a wider scale.

3. Sustainable land management programmes

LandCare, South Africa

91. The national LandCare programme is a community-based, government-supported natural resource management programme. The concept of LandCare was first developed in Australia and involves the participation of grass-roots community groups, native populations, landowners, and government institutions. The success of the programme is dependent mainly on the farming community, which is responsible for the identification, implementation and monitoring of the land base. LandCare in South Africa aims at developing and implementing integrated approaches to natural resource management which are efficient and consistent with sustainable development principles. LandCare is intended to ensure the sustainable management of agricultural resources in order to optimize production, food security and job creation. LandCare has established partnerships between the public sector, communities and the private sector. There are several themes which fall within the programme: WaterCare, VeldCare, SoilCare and JuniorCare.

92. Groups interested in implementing LandCare projects apply for funding through the Department of Agriculture. Successful proposals should be in accordance with the objectives of the National Agricultural Policy, the Water and Forestry Management Strategy, the Land Reform Programme, and the National Environmental Strategy.

93. For the fiscal year 2001-2002, an allocation of 25 million South African rand was set aside for the implementation of LandCare projects; under the WaterCare theme, 11 irrigation schemes were selected in four regions of the northern province of Limpopo. Those projects involved the holistic and integrated rehabilitation and restructuring of the irrigation systems. Fourteen projects, valued at approximately 4.6 million South African rand, were selected under the VeldCare project, and they benefited 545 communal farmers by clearing away alien invasive species and controlling bush encroachment. SoilCare projects in Eastern Cape and KwaZulu-Natal were valued at 7 million South African rand and covered seven projects related to soil conservation and the rehabilitation of degraded areas. Finally, three JuniorCare projects totalling 1 million South African rand were also implemented.

Biodegradable inputs reduce costs and pressure on the environment

94. The Federation of Free Farmers of the Philippines, a national farmers organization, has been successfully testing an organic rice programme in around 20 villages throughout the country. The programme aims at helping to reduce farmers' costs, particularly in terms of seeds and fertilizer, to rejuvenate and restore soil fertility, and to generate higher income from the sale of premium organic rice products. This project is also seen as a contribution of farmers to environmental sustainability in general, and to the reduction in greenhouse gas emissions in particular (through reduced petroleum-based fertilizer application and the use of

biodegradable inputs). The Federation of Free Farmers of the Philippines has been experimenting with biofertilizer technologies, such as nitrogen-fixing inoculants, which are less costly, more easily applied to plants and environmentally friendly. Ultimately, the Federation is working on the development of an environmentally sustainable farming approach, while providing farmers with higher incomes in terms of reduced costs of production, higher quality of their products and improved yields.

Alternative Land Use Services in Canada for the development of sustainable land management tools

95. In Canada, the vast majority of environmental management is done by individual farmers, ranchers and landowners. Alternative Land Use Services is a proposal for an agricultural conservation programme that taps into the opportunity to partner with local people and their communities to induce environmental change. This proposal, the first in its kind in Canada, recognizes the value of conserving and restoring Canada's natural capital, while also respecting and rewarding the important role that rural landowners play in environmental management.

96. Alternative Land Use Services is unique because it is incentive based. Farmers have always acted as land stewards and have provided ecological goods and services to Canadians. The programme proposes a fee for service concept, where the landowner is paid a fair price for the environmental benefits that he or she creates and maintains through a variety of land management tools, such as natural and ecologically sensitive lands, riparian areas or wetlands.

97. This programme would build local capacity for agricultural conservation. It is a national programme with a local focus. Farmers are in favour of Alternative Land Use Services as a conservation programme that offers practical long-term solutions. The programme will mobilize farmers, ranchers and landowners as well as conservationists to provoke a national discussion on the environmental contributions of agriculture and the ecological services that farmers provide. The Canadian Federation of Agriculture producers support the Alternative Land Use Services programme, which was developed by farmers as a practical solution to environmental issues. The programme is also trade neutral. Groups of supporters of Alternative Land Use Services in several provinces across Canada are currently working on pilot project proposals to test the programme as a national agri-environmental initiative. The first pilot was launched in Manitoba in November 2005.

IV. Lessons learned and new opportunities to expedite implementation

98. Even though there has been significant progress, much remains to be done.

99. First, the road to sustainable agriculture and sound rural development implementation strategies around the world needs to encompass participatory approaches. A farmer-centred approach to agriculture and rural development should prevail.

100. Second, farmers are doing a great deal to follow sustainable agricultural practices and to provide ecosystem services. These efforts should be better documented so that they can be scaled up and replicated in other regions and

countries. Further, farmers should receive incentive payments for the ecosystem services that they provide, since they benefit the whole of society.

101. The role of the Government has to be redefined in order to achieve this. Withdrawal of government support for agricultural services has destabilized rural areas and exacerbated the poverty problem. Governments need to re-engage with farmers, scientists and other stakeholders in order to exploit the full potential of agriculture to reduce poverty and conserve natural resources.
